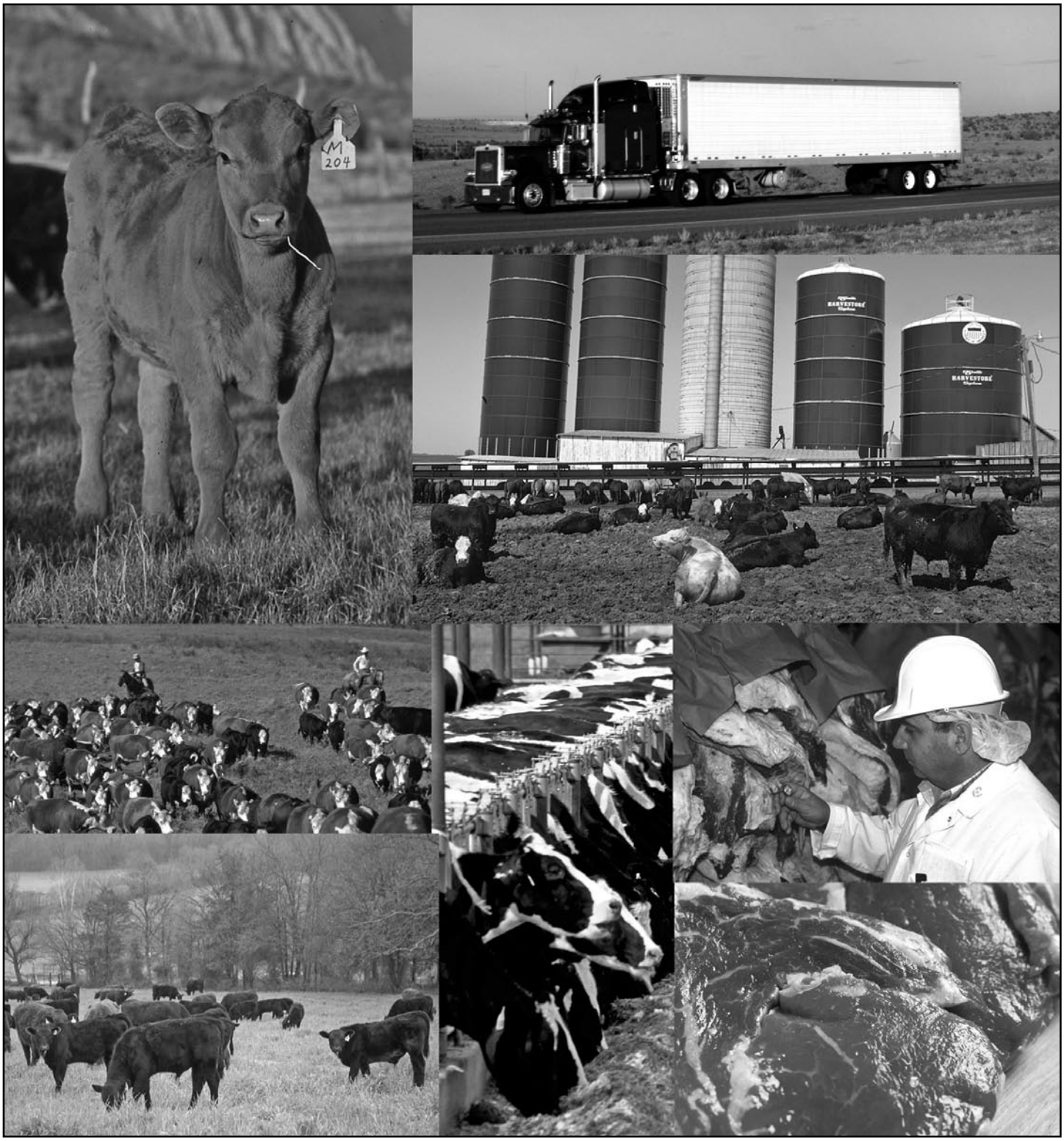
Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service

The Economic Impact of BSE on the U.S. Beef Industry:

Product Value Losses, Regulatory Costs, and Consumer Reactions



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Executive Summary

Background

For nearly 2 decades the U.S. beef industry has been impacted by bovine spongiform encephalopathy (BSE). Since the emergence of the disease in the United Kingdom and the subsequent discovery of a possible link between BSE and fatal new variant Creutzfeld-Jacob Disease (vCJD) in humans, various agencies of the United States government have implemented measures to prevent BSE from entering the country, prevent its spread if it were to be discovered here, and safeguard human health. These measures included restrictions on imports of live animals, meat products and feedstuffs, restrictions on feeding certain ruminant derived tissues back to ruminant animals, a disease surveillance program, and restrictions on blood donations from individuals who previously resided in BSE affected countries. As the disease spread outside Europe to Japan and, in mid-2003, to Canada, USDA enhanced its surveillance efforts and increased funding for BSE related research. Regulatory efforts to counter the disease were further strengthened when, on December 23, 2003, it was reported that a dairy cow in Washington state had tested positive for BSE.

Regulatory Response to the December 23 Case

To enhance protection of human health and reassure export markets about the safety of U.S. beef, the Food Safety Inspection Service (FSIS) of USDA issued rules designating certain tissues (e.g., small intestine and tonsils of all cattle; brains, eyes, spinal cord of cattle over 30 months of age) as specified risk materials (SRM) not allowed in human food. FSIS also banned entry of material from downer cattle into the human food chain. To further reduce the risk of BSE spreading, the Food and Drug Administration (FDA) proposed enhancing the existing ruminant feed ban by removing the exemption for blood products and banning plate waste and poultry litter. The Animal and Plant Health Inspection Service (APHIS) stepped up BSE surveillance efforts and announced that they would conduct BSE tests on "as many cattle as possible" from the population of high-risk cattle in a 12- to 18-month period beginning in June 2004. This represented more than a tenfold increase in testing relative to previous surveillance levels.

Costs Associated with BSE Regulations

The regulations introduced in 2004 led to changes in cattle procurement, employment, employee training requirements, food safety plans, capital investments, and marketing opportunities for the beef industry. To assess the impact on industry, we interviewed seven firms to gather data on costs associated with the new regulations. The seven firms represented more than 60 percent of 2003 beef slaughter and were sufficiently diverse to represent a reasonable cross section of the beef packing industry.

On average, firms incurred additional labor costs of $0.45 per head of daily capacity. These costs arose primarily as a result of regulations requiring the creation of positions to age animals using postmortem dentition, to deal with non-ambulatory animals, and to segregate SRM material. One-time costs of training existing employees to comply with new FSIS rules varied from $13,800 to $100,000 across firms. Altering HACCP plans and record keeping procedures resulted in relatively small cost increases - a combination of nominal initial investments plus ongoing labor costs of approximately $0.01 per head. Changes in capital investments varied across firms. Some were able to achieve compliance without any new investments, whereas others invested up to $84,000 in long-term assets. All firms had investments in certain assets that they now consider obsolete. On average, the loss resulting from investments being made obsolete was more than $700,000 per firm.

The new regulations also resulted in revenue losses due to products being banned from the food supply. In particular, the condemnation of small intestines from all cattle has been a hotly debated topic. We estimate that, on average, firms that previously sold small intestines are foregoing an average of $3.68 per head in potential revenue. That loss however, is contingent on the availability of export markets for the product. For non-fed

slaughter (animals over 30 months of age), condemnation of bone-in cuts containing vertebral column and restrictions on the use of advanced meat recovery (AMR) systems reduce per-head revenues by approximately $8.50 and $9.36, respectively. These decreases only apply to firms engaged in these respective activities. Also prohibited from the food supply are non-ambulatory cattle. In 2004, this regulation resulted in an estimated loss of $64.6 million to the beef packing sector. Considering all these areas of change, and ignoring one-time expenses, we estimate the net economic cost to the beef industry in 2004 from FSIS Interim Final Rules to be approximately $200 million.

We also considered the potential impacts of additional BSE measures that have been proposed, but not yet implemented. One such policy being considered is a ban on SRM in animal feed. We estimate that if this proposal is implemented, the associated costs would be $2.16 per head for fed slaughter and $6.77 per head for non-fed slaughter. We estimate that a complete ban on feeding of ruminant derived proteins would cost $14.01 per fed animal and $12.35 per non-fed, in addition to adding $4.50 per head to feed costs for a fed animal.

Market Response to the December 2003 Case

Export Markets

Within days of the Washington state BSE announcement, 53 countries, including major markets such as Japan, Mexico, South Korea and Canada, banned imports of U.S. cattle and beef products. In 2003, U.S. beef exports were valued at $3.95 billion and accounted for 9.6 percent of U.S. commercial beef production. The import bans caused U.S. beef exports to plummet, and although some important markets, including Mexico and Canada did reopen during 2004, export quantities for the year declined 82 percent below 2003's level.

The loss of export markets increased the quantities available on the domestic market thereby depressing domestic prices below levels they would have attained if exports were possible. We developed a trade model to estimate the impact of export losses on the beef industry. The model incorporated assumptions about the elasticity of domestic demand for beef and offal in order to estimate the price impact of additional supplies on the domestic market. Because the resulting loss estimates depend on the elasticity estimates, our report includes results of a sensitivity analysis to provide a range of probable loss estimates. Results suggest that total U.S. beef industry losses arising from the loss of beef and offal exports during 2004 ranged from $3.2 billion to $4.7 billion.

The United States has yet to regain access to the Japanese and South Korean beef export markets, the second and third largest markets for U.S. beef during 2003. If the United States regained access to these two key markets, and exported the same percentage of U.S. production to these two countries in 2004 as in 2003, wholesale revenue per head would have increased between $45 and $66 per head for every head slaughtered in the United States. If exports to Japan and South Korea were only one-half the 2003 level, as a percentage of U.S. production, wholesale revenue per head slaughtered would have increased $22 to $32.

Domestic Market

In the week following the December 2003 announcement, cattle prices fell by about 16 percent. Consumer surveys at that time suggested that U.S. domestic beef demand could fall by as much as 15 percent. However, prices recovered in early 2004 as it became clear that U.S. consumer demand had been impacted only minimally, if at all. In fact, market data on beef disappearance and retail prices suggest that consumer demand for beef actually strengthened in the first half of 2004. However, given that the animal infected with BSE in Washington state originated in Canada and could plausibly be viewed as an isolated case, the possibility remains that an additional BSE discovery in an indigenous animal could have a significant negative impact on demand.

To investigate the potential impact of additional U.S. BSE discoveries we used a regionally targeted consumer survey. The results suggest that most consumers (77 percent) did not change consumption habits because of the first U.S. BSE case, but that subsequent discoveries, particularly of multiple cases, could have a significant impact on demand. However, we cannot infer from our results that an additional isolated case of BSE

in the United States would have a significant impact on domestic beef demand.

Testing

Voluntary testing for BSE has been proposed as a means of regaining access to lost export markets, but USDA has turned down a request from a private firm to conduct such testing. The beef industry is sharply divided on the issue. Proponents of voluntary testing tend to view it in terms of a marketing decision with expected benefits outweighing costs, at least in the short run. Opponents see testing as unnecessary and costly, as setting a dangerous precedent in terms of acquiescing to an unreasonable customer requirement, and as a procedure with no scientific justification in terms of risk reduction to consumers.

In our analysis we estimate costs and potential benefits for a range of testing/market-access scenarios. Voluntary testing by a single, small firm would provide little or no benefit to producers because the increase in the derived demand for cattle generated from such a small-scale increase in exports would have an insignificant impact on domestic cattle prices. The policy could, however, result in significant profits for a firm engaged in testing, at least in the short run, if testing opened up additional markets for a firm's beef products. If additional market access is obtained through BSE testing, more firms would be attracted to testing and domestic cattle prices would increase. Our analysis suggests that if all slaughter animals are tested, but there is no increase in access to either the Japanese or South Korean markets, the result would be a net loss of $17.50 (the estimated cost of testing) per head. Alternatively, if full access to the Japanese and South Korean markets is regained without implementing a broad based BSE testing program, the potential revenue gain ranges from about $45 to $66 per head.

Introduction

For nearly 2 decades, the U.S. beef industry has been impacted by the disease known as bovine spongiform encephalopathy (BSE). Since the emergence of BSE in the United Kingdom and ensuing reports from the scientific community of the possible link between BSE and the fatal new variant Creutzfeld-Jacob Disease (vCJD) in humans, the United States Department of Agriculture (USDA) has taken several regulatory steps related to BSE. Changes in international trade policy, beef production and feeding practices, and in beef processing and rendering have been instituted with the aim of reducing the likelihood of introducing BSE into the U.S. cattle herd and preventing its spread, should it appear.

In May of 2003, a beef cow in Canada tested positive for BSE. This was the first domestic case of BSE in North America. A BSE case this close to home, in a country with a similar beef production system, resulted in a heightened awareness of the threat to the U.S. beef industry. The May 2003 case resulted in immediate restrictions on imports of Canadian beef and cattle, and increased scrutiny of USDA policies by consumer, industry, and trade groups. Although U.S. consumers' aggregate demand for beef was not substantially affected, specific consumer concerns resulted in U.S. beef packers and processors altering some production practices and types of products offered.

Concern about BSE reached an entirely new level when, on December 23, 2003, it was reported that a dairy cow in Washington state had tested positive for the disease. Immediately, the United States saw exports to Japan, South Korea, Mexico, and other major markets come to a halt. In the ensuing weeks, the USDA announced several new BSE prevention and testing protocols. These actions, aimed at assuring consumers of the safety of the U.S. beef supply and re-establishing trade, have come at a cost to the beef industry and have not been without controversy.

The USDA has been both praised and criticized by players in all segments of beef production and marketing. A variety of amendments to current regulatory policies have been recommended, ranging from slight modification to a total overhaul. Several studies have been conducted and/or commissioned by government agencies, university researchers, producer groups, individuals, and consulting groups to estimate economic impacts of current BSE policy and costs of alternative policies. With a myriad of analyses and recommendations, it is difficult to sift through the reports and articles available to obtain reliable, succinct information on USDA BSE-related policy and the related economic impacts. The general objective of this study is to address this situation by providing a summary of the industrywide economic impacts resulting from both regulatory and market sources.

1.1 Study Objectives

The specific objectives of this study are as follows:

1) Provide a brief summary of the history of BSE and BSE-related regulations imposed by USDA before and since December 23, 2003.
2) Estimate market losses resulting from the December 23, 2003 BSE case.
3) Estimate cost and revenue changes in the U.S. beef industry. This component focuses on the beef packing and rendering sectors and addresses changes in costs or revenues resulting from alterations in procedures, processing, storage, and marketing made to comply with USDA regulations.
4) Present alternative policy strategies for dealing with BSE and their associated costs.
5) Estimate the potential effect on U.S. beef demand if additional U.S. BSE cases are discovered.

1.2 Structure of the Study

The next section summarizes the regulatory environment related to BSE in the United States. Sections 3 and 4 discuss the market losses and changes in the beef packing sector resulting from the December 2003 case in Washington state. Section 5 analyzes proposed changes in feeding regulations and their potential costs, while Section 6 discusses the potential impact on domestic demand if new cases of BSE are found in the United States. Finally, Section 7 discusses some policy options that have been the subject of recent debate in the industry, including proposals to test more cattle in an effort to regain lost export markets.

The Regulatory Environment in the United States

U.S. policy regarding BSE has been developing for several years. While recent changes have been widely reported, they are built on years of research, debate, and policy development. A basic understanding of this history is essential to the current discussion. Appendix 1 presents a chronological summary of BSE related developments drawn from work by Fox and Peterson and by Franco.

Bovine spongiform encephalopathy, more commonly known as "mad cow disease," first surfaced in the United Kingdom in 1984 and was confirmed to be a bovine Transmissible Spongiform Encephalopathy (TSE) in 1986. TSEs are a broad class of diseases affecting the brain and central nervous system. The infectious agent of TSEs is a prion[1] protein. Infection eventually results in spongy lesions on the brain, central nervous system symptoms, and, in all cases, death. Examples of TSEs include scrapie in sheep and chronic wasting disease in elk and deer. One of the most well-known TSEs affecting humans is Creutzfeld-Jacob Disease (CJD), which apparently occurs spontaneously at a very low rate[2].

2.1 History of U.S. BSE-Related Policy

The United States declared BSE a legally reportable disease in the same year it was categorized as a TSE. Over the next 5 years the USDA began efforts to research the pathology of BSE and laid the foundation of a basic surveillance program. During this time, epidemiologic research indicated that meat and bone meal (MBM) containing the infectious agent was responsible for spreading the disease. The United States subsequently banned imports of MBM from the United Kingdom. The early 1990s saw import restrictions expanded to all countries with known cases of BSE, while the surveillance program grew to include a larger sample size and non-ambulatory ("downer")[3] cattle. In a 1991 USDA internal analysis (and in an update of that analysis in 1993), efforts were made to assess the risk posed by BSE to the U.S. beef herd. At this point, BSE was viewed as an animal health issue and addressed as such.

The situation changed drastically in 1996 when the British government announced the possible linkage between BSE and 10 cases of new variant Creutzfeld-Jacob Disease (vCJD) (SEAC). Although debate persists about this relationship, a majority of researchers in the medical and epidemiological sciences agree it does exist. This apparent relationship between consumption of BSE material and a fatal human disease has driven strong consumer responses in the European Union to BSE outbreaks (Fox and Peterson) and both reactive and proactive regulatory actions by many governments, including the United States.

Addressing BSE as both a human and an animal health issue, the USDA and its agencies stepped up efforts to protect the United States from the introduction and spread of the disease. In 1997 FDA banned the use of high risk ruminant products in ruminant feed. That same year, USDA stopped imports of live animals and high risk bovine products from all of Europe. Although many in industry and government touted these firewalls as more than sufficient protection against BSE, the USDA felt the need to update previous BSE risk assessments.

In 1998 the USDA entered into a cooperative agreement with the Harvard Center for Risk Analysis to perform an exhaustive study of the risk of introduction of BSE to the U.S. beef herd, the risk of BSE spreading among the beef herd, and the risk posed to U.S. consumers by BSE. In conjunction with Tuskegee University College of Veterinary Medicine, the Harvard Center for Risk Analysis published the results of this study in 2001, with an update responding to review comments published in 2003. This mammoth effort is the most widely cited study by industry, government, and academia in reference to the risk of BSE in the United States. The Harvard study and results are voluminous, but some of the major findings were:

1) The United States is highly resistant to the introduction of BSE and similar diseases.
2) If introduced, BSE is extremely unlikely to become established in the United States.
3) If BSE were present in the beef herd, only a small amount of BSE-contaminated material would be available for human consumption. The greatest risk would

[1] *The prion concept is not accepted by all in the scientific community. However, it was first presented by Pruisner in the early 1980s (see, for example, Pruisner, 1984) and has withstood 2 decades of peer comment and review to remain the most widely-accepted explanation for the infectious agent of BSE (and other TSEs).*

[2] *Center for Disease Control and Prevention reports, based on data from 1979 to 1994, indicate the death rate due to CJD is about one per million people in the United States.*

[3] *There is often confusion and inconsistency over how the term "downer" is used. In this report "downer" refers to any animal that is unable to rise and walk on its own power, regardless of reason. This includes injured animals. This definition is consistent with current USDA/APHIS usage of the word "downer" and the term "non-ambulatory."*

come from consumption of brain, spinal cord and meat derived from advanced meat recovery systems with a lesser risk associated with spinal cord present in bone-in cuts (such as T-bones) and consumption of intestines.

The findings of the Harvard study bolstered confidence in U.S. measures to protect against BSE and, it seems, also may have boosted consumer confidence in beef.

In 2001, the first indigenous case of BSE to be confirmed outside of Europe was found in Japan. The United States had, months earlier, closed beef trade with Japan due to concern about foot and mouth disease and simply kept the border closed following the BSE discovery. The USDA also boosted its surveillance program, planning to double the number of cattle tested in 2002 relative to 2001. The Japanese case was obvious cause for concern since this was evidence that the disease could spread to other continents.

2.2 BSE in North America

The first indigenous case of BSE found in North America was in an Alberta beef cow.[4] The positive test results were made public on May 20, 2003. The United States immediately halted imports of Canadian cattle and beef products. Three months passed before serious consideration was given to importing any Canadian beef related products and then only on a limited basis, primarily allowing boneless cuts from animals less than 30 months of age. A case of BSE this close to home brought changes to the U.S. meat packing industry. Consumer concerns prompted many firms to move away from including AMR product in ground beef and some moved away from selling certain by-products, such as brains. The USDA worked with the Canadian government as they stepped up Canadian firewalls against BSE. As it turned out, this preparation paid off when, on December 23, 2003, the second North American case of BSE was reported in a dairy cow in Washington state. Although the cow was later found to be of Canadian origin, the case was perceived as, and around the world broadly considered, a U.S. case and was addressed as such by domestic and international consumer, industry, and government groups.

[4] *In 1993, a beef cow tested positive for BSE in Canada. However, since the animal was imported from the United Kingdom, it is not considered an indigenous case for North America.*

2.3 U.S. Reaction to the BSE Case in Washington State

Reactions to the confirmed presence of BSE in the United States were immediate, both domestically and abroad. Within days, 53 countries halted importation of U.S. cattle and beef products. These market closures included Japan, a major importer of U.S. beef and an important niche market for many beef by-products not highly valued by U.S. consumers. The situations with individual countries have been fluid in recent months and the details of these changing trade relationships are addressed in Section 3. On December 30, 2003, U.S. Secretary of Agriculture, Ann Venneman announced heightened measures to protect the food supply and to protect against the spread of BSE in the U.S. beef herd. These preliminary rules, as posted by the Food Safety Inspection System (FSIS) on January 12, 2004, would become final interim rules and, thus, mandates to U.S. meat slaughterers, processors, and fabricators. The rules are summarized as follows (FSIS):

Interim final rule "Prohibition on the Use of Specified Risk Materials for Human Food and Requirements for the Disposition of Non-Ambulatory Disabled Cattle" (69 FR 1862):

- Designates the brain, skull, eyes, trigeminal ganglia, dorsal root ganglia (DRG), spinal cord, vertebral column (excluding the vertebrae of the tail, the transverse processes of the thoracic and lumbar vertebrae, and the wings of the sacrum) from cattle 30 months of age and older; and the tonsils and the distal ileum of all cattle as specified risk materials (SRMs);
- Declares that SRMs are inedible and prohibits their use for human food;
- To ensure effective removal of the distal ileum, requires that the entire small intestine be removed and disposed of as inedible;
- Requires that establishments that slaughter cattle, or establishments that process the carcasses or parts of cattle, develop, implement, and maintain, written procedures for the removal, segregation, and disposition of materials designated as SRMs. Establishments must incorporate these procedures into their HACCP plans, Sanitation SOPs, or other prerequisite program;

- Prohibits mechanically separated (MS) (beef) food product for human food;
- Requires that all non-ambulatory disabled cattle presented for slaughter be condemned and prescribes requirements for the handling and disposition of such cattle.

Interim final rule, "Meat Produced by Advanced Meat/Bone Separation Machinery and Meat Recovery (AMR) Systems" (69 FR 1874):

- Prohibits the use of vertebral columns and skulls of cattle 30 months of age and older in the production of AMR product (product derived from these materials is adulterated);
- Prohibits the incorporation of any brain, trigeminal ganglia, spinal cord, or DRG in AMR product identified as "meat";
- Finalizes restrictions related to bone solids and bone marrow (as measures by calcium and iron content);
- Requires establishments that produce AMR product to document their process controls in writing, and if the establishment processes cattle, the program must be in its HACCP plan Sanitation SOP, or other prerequisite program.

Interim final rule, "Prohibition on the Use of Certain Stunning Devices Used to Immobilize Cattle" (69 FR 1885):

- Prohibits the use of penetrative captive bolt stunning devices that deliberately inject air into the cranial cavity of cattle.

Federal Register Notice, "Bovine Spongiform Surveillance Program" (69 FR 1892)

- Announces that FSIS inspection program personnel will no longer pass and apply the mark of inspection to the carcasses and parts of cattle that are selected for testing by APHIS for BSE testing until the test results are received and the results are reported negative for BSE.

These rules had varying effects on the packing and rendering sectors. Some rules, such as the banning of air injection stunning and the banning of mechanically separated beef from the food supply, seem to be largely irrelevant as most slaughter firms had not been relying on such practices. Other rules, such as banning the small intestine from the food supply, had immediate procedural and economic effects. Section 4 addresses the effects of these rules.

In 2004 the FDA also stepped up its BSE safeguards. SRMs (as defined in the FSIS rules) were prohibited from entering the FDA-governed food supply, which includes dietary supplements. FDA released a recommendation that feed manufacturers producing non-ruminant feed, and using any proteins prohibited from ruminant feed, maintain distinct lines and equipment for that feed. This recommendation has passed the public comment stage and could be elevated to final rule status rather quickly. FDA also posted industry guidance that no material from BSE-infected cattle be used in any animal feed. Further guidance was given that all specified risk material (SRM), as defined in the FSIS interim final rules, be condemned from use in all animal feed (including pet food). This last measure has now passed the public comment phase and can become an interim final rule very quickly, should FDA deem it necessary.

FDA also announced plans to publish interim final rules removing the exemptions for bovine blood and blood products from the 1997 feed ban and banning plate waste and poultry litter from ruminant feed. However, like the FDA proposals related to SRMs, these rules have yet to be implemented (see Section 5 for more detail).

The Animal and Plant Health Inspection Service (APHIS), the agency of the USDA responsible for testing for BSE, initiated a new BSE surveillance program in 2004. APHIS announced that, beginning June 2004, they would test "as many animals as possible" from the high risk population with the next 12 to 18 months. The statistical information provided by APHIS stated that, assuming BSE positive cases were limited to the high risk population, testing 268,500 cattle within 12 months would allow for detection of BSE at a rate of 1 in 10 million at a 99 percent level of confidence. In addition to testing high risk cattle APHIS planned to test 20,000 "apparently normal" cattle over 30 months of age. These cattle are scheduled to come from 40 U.S. plants that deal with the majority of the nation's non-fed slaughter. APHIS reported that, as of December 2004, more than 121,000 animals had been tested with no positives found.

Market Losses Following the December 2003 Case

Within hours of the announcement that a single BSE case had been identified in Washington state, U.S. beef trading partners halted or restricted imports of U.S. beef and by-products. As a result, U.S. beef exports were minimal during the first quarter of 2004. Subsequently, the United States regained limited access to two important beef markets, Mexico and Canada, as well as to several smaller markets. However, the United States has yet to regain access (as of early 2005) to several key markets, notably Japan and South Korea. Although cattle prices remained relatively high during 2004, prices would have been significantly higher if beef export markets had continued to function normally. To fully understand the extent of the impact, it is useful to review the role of beef exports in the U.S. beef industry and how it has changed over time.

Prior to the mid-1980s, beef exports were a minor component of total demand for U.S. beef. As recently as 1985, the value of U.S beef and variety meat exports totaled just $715 million dollars (332 million pounds, or 1.4 percent of U.S. beef production). By 2003, beef exports were valued at $3.95 billion (FAS), with total exports of 2.5 billion pounds accounting for 9.6 percent of total U.S. production.

It is important to note not only the overall growth in exports, but also which products are exported. U.S. beef processors do not simply process live cattle and ship live animal equivalents in the form of boxed beef and beef by-products to overseas customers. Instead, beef processors disassemble beef carcasses into their component parts and sell the parts to the highest valued markets (net of transportation costs). While the domestic market absorbs the major share of most meat products, export markets are an increasingly important outlet for certain beef and offal products. For example, Marsh (1999) reported that 50 to 60 percent of hides and offal products were normally exported.

3.1 U.S. Beef Exports by Product Category

Disaggregated meat export data is reported by the USDA Foreign Agricultural Service (FAS) based on ten-digit codes specified by the U.S. Census Bureau. Unfortunately, many Census Bureau meat export categories contain products from various species. While some export categories clearly represent beef products, others are ambiguous with respect to species. These latter categories were excluded from our analysis since it was impossible to ascertain the value or quantity of beef versus other meat components. We use FAS monthly data to examine export trends for 33 beef product categories between January 1999 and August 2004. These categories are listed in Appendix 2.

3.2 Ranking Beef Exports by Category

Although the United States exports a myriad of beef items and by-products, the bulk of exports are concentrated in a relatively small number of categories. Table 3.1 reports beef export value by category in several different ways. During 2003, 91 percent of exports were drawn from just nine categories, with the two largest categories accounting for approximately 60 percent of exports. The two largest categories were "fresh or chilled boneless beef," (37 percent) and "frozen boneless beef," (23 percent), with a combined value of nearly $2.4 billion in 2003. Boneless beef (fresh and frozen) exports during 2003 totaled 1.4 billion pounds. Using USDA's standard carcass to boneless weight conversion, the United States produced approximately 18.5 billion pounds of boneless (equivalent) beef during 2003. Thus, boneless beef exports during 2003 amounted to about 7.5 percent of boneless beef production.

Several of the remaining categories represented relatively large components of total export value. The third largest export category was "bone-in frozen beef," which accounted for 9 percent of export value during 2003. Next on the list was "frozen beef tripe," which contributed 6 percent of export value. "Frozen edible offal product" was the fifth largest beef export category during 2003, accounting for 5 percent of total beef export value. Exports in the third through fifth largest categories were

Table 3.1. *U.S. Beef and By-product Export Values, By Category.*

Category	Exports Value (Thousand Dollars)			Percentage of Total Exports Value		Value Change from 2003 to 2004	% Change in Value from 2003 to 2004	% of Total Exports (2003)	Cumulative Percent of Total Exports (2003)
	2003	Jan-Aug 03	Jan-Aug 04	Jan-Aug 03	Jan-Aug 04				
Meat of Bovine Animals, Boneless, Fresh or Chilled (Does not include processed items)	$1,441,736	$999,078	$155,595	38.14%	32.87%	$(843,483)	-84.4%	36.5%	36.5%
Meat of Bovine Animals, Boneless, Frozen (Does not include processed items)	$917,579	$587,622	$25,378	22.43%	5.36%	$(562,244)	-95.7%	23.2%	59.7%
Meat of Bovine Animals, Cuts with Bone In, Frozen (Does not include processed items)	$342,381	$219,331	$6,268	8.37%	1.32%	$(213,063)	-97.1%	8.7%	68.4%
Beef Tripe, Frozen	$254,828	$165,574	$88,473	6.32%	18.69%	$(77,101)	-46.6%	6.4%	74.8%
Other Edible Offal of Bovine Animals, Frozen	$196,734	$128,542	$15,508	4.91%	3.28%	$(113,034)	-87.9%	5.0%	79.8%
Meat of Bovine Animals, Fresh or Chilled, Boneless, Processed	$164,448	$103,182	$63,753	3.94%	13.47%	$(39,429)	-38.2%	4.2%	84.0%
Tongues of Bovine Animals, Edible, Frozen	$105,620	$67,154	$2,886	2.56%	0.61%	$(64,268)	-95.7%	2.7%	86.6%
Meat or Meat Offal of Bovine Animals, NESOI[1], Prepared or Preserved	$84,494	$50,864	$22,113	1.94%	4.67%	$(28,751)	-56.5%	2.1%	88.8%
Livers of Bovine Animals, Edible, Frozen	$72,016	$44,310	$17,947	1.69%	3.79%	$(26,363)	-59.5%	1.8%	90.6%
Meat of Bovine Animals, Cuts With Bone In, Fresh or Chilled (Does not include processed items)	$71,598	$53,193	$2,242	2.03%	0.47%	$(50,951)	-95.8%	1.8%	92.4%
Bovine Semen	$46,122	$30,219	$31,657	1.15%	6.69%	$1,438	4.8%	1.2%	93.6%
Meat of Bovine Animals, Frozen, Boneless, Processed	$35,317	$21,432	$11,661	0.82%	2.46%	$(9,771)	-45.6%	0.9%	94.5%
Bovine Animals, Live, NESOI[1]	$33,913	$27,108	$4,166	1.03%	0.88%	$(22,942)	-84.6%	0.9%	95.3%
Meat of Bovine Animals, Frozen, Other Cuts With Bone In, Processed	$27,152	$17,615	$2,956	0.67%	0.62%	$(14,659)	-83.2%	0.7%	96.0%
Guts, Bladders and Stomachs of Animals; Beef Intestine Frozen	$26,842	$19,683	$401	0.75%	0.08%	$(19,282)	-98.0%	0.7%	96.7%
Lips of Bovine Animals, Frozen	$23,261	$15,014	$5,954	0.57%	1.26%	$(9,060)	-60.3%	0.6%	97.3%
Bovine Animals, Live, Purebred Breeding, Dairy, Female	$18,222	$13,728	$339	0.52%	0.07%	$(13,389)	-97.5%	0.5%	97.7%
Offal of Bovine Animals, Edible, Fresh or Chilled	$16,175	$8,725	$1,687	0.33%	0.36%	$(7,038)	-80.7%	0.4%	98.1%
Meat of Bovine Animals, Fresh or Chilled, Other Cuts With Bone In, Processed	$13,393	$6,882	$1,081	0.26%	0.23%	$(5,801)	-84.3%	0.3%	98.5%
Hearts of Bovine Animals, Frozen	$12,512	$8,361	$4,114	0.32%	0.87%	$(4,247)	-50.8%	0.3%	98.8%
Meat of Bovine Animals, Salted, In Brine, Dried or Smoked	$10,629	$6,926	$514	0.26%	0.11%	$(6,412)	-92.6%	0.3%	99.1%

Carcasses and Half-carcasses of Bovine Animals, NESOI, Fresh or Chilled	$7,102	$5,040	$668	0.19%	0.14%	$(4,372)	-86.7%	0.2%	99.3%
Carcasses and Half-carcasses of Bovine Animals, NESOI, Frozen	$6,143	$4,262	$969	0.16%	0.20%	$(3,293)	-77.3%	0.2%	99.4%
Dairy Cattle Embryos	$4,335	$2,635	$2,929	0.10%	0.62%	$294	11.2%	0.1%	99.5%
Bovine Animals, Live, Purebred Breeding, Dairy, Male	$3,866	$2,222	$47	0.08%	0.01%	$(2,175)	-97.9%	0.1%	99.6%
Bovine Animals, Live, Purebred Breeding, Except Dairy, Female	$3,676	$2,447	$57	0.09%	0.01%	$(2,390)	-97.7%	0.1%	99.7%
Bovine Animals, Live, Purebred Breeding, Except Dairy, Male	$3,553	$2,897	$12	0.11%	0.00%	$(2,885)	-99.6%	0.1%	99.8%
Carcasses And Half-carcasses of Veal, Fresh or Chilled	$2,622	$2,213	$196	0.08%	0.04%	$(2,017)	-91.1%	0.1%	99.9%
Kidneys of Bovine Animals, Frozen	$1,812	$1,050	$1,256	0.04%	0.27%	$206	19.6%	0.1%	99.9%
Cattle Embryos, Except Dairy Cattle	$1,486	$960	$1,921	0.04%	0.41%	$961	100.1%	0.0%	99.9%
Carcasses and Half-carcasses of Veal, Frozen	$1,159	$806	$226	0.03%	0.05%	$(580)	-72.0%	0.0%	100.0%
Sweetbreads of Bovine Animals, Frozen	$688	$480	$52	0.02%	0.01%	$(428)	-89.2%	0.0%	100.0%
Brains of Bovine Animals, Frozen	$225	$146	$276	0.01%	0.06%	$130	89.0%	0.0%	100.0%
Total	$3,951,639	$2,619,701	$473,302			$(2,146,399)	-81.9%		

[1] *Non Elsewhere Specified or Included*

worth $793 million in 2003.

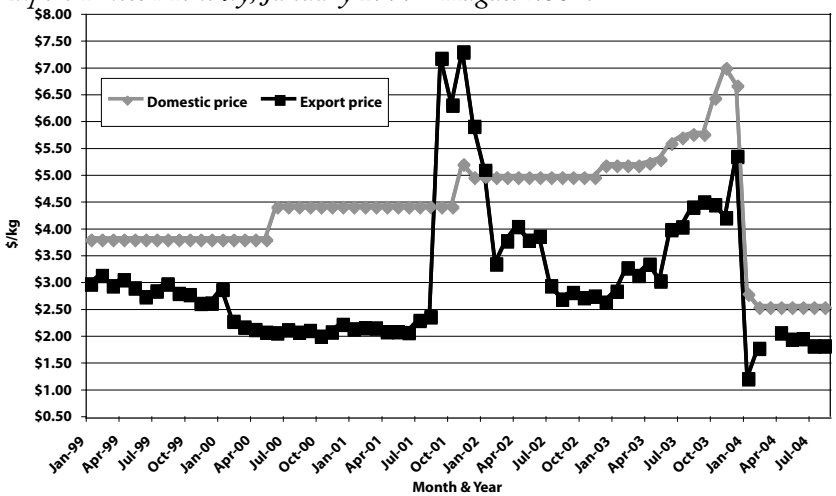
The export categories ranked sixth through ninth in value during 2003 were "fresh or chilled processed boneless beef," "frozen beef tongues," "prepared or preserved meat or meat offal," and "livers." These categories collectively accounted for almost 11 percent of 2003 exports, with a combined value of $426 million. Among these four categories, beef tongues received the most attention during 2004. Although its contribution to total export value was modest compared to some of the larger categories, a large proportion of U.S. tongue production was typically exported. FAS reports that beef tongue exports totaled 60.1 million pounds during 2003, out of a total estimated production of about 117.3 million pounds (3.3 pounds per head (U.S. Meat Export Federation) times 35.5 million head processed). Thus, exports accounted for more than 50 percent of total tongue production during 2003.

3.3 Beef Exports Decline in 2004

During 2003 the value of U.S. exports of beef and beef by-products (as measured by the 33 *beef only* Census Bureau categories) totaled $3.9 billion, representing an average monthly export value of $325 million. In contrast, during January-August 2004 beef and related by-product exports totaled just $473 million, a monthly average of $59 million. This translates into an 82 percent decline in the monthly average value of exports.

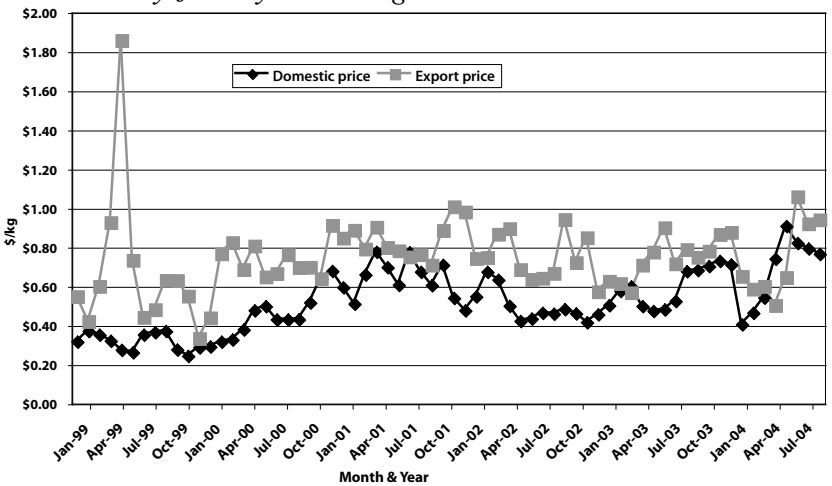
The decline in exports

Figure 3.1. *Domestic Cattle Tongue Prices vs. Frozen Tongue Imputed Export Prices Monthly, January 1999 – August 2004.*



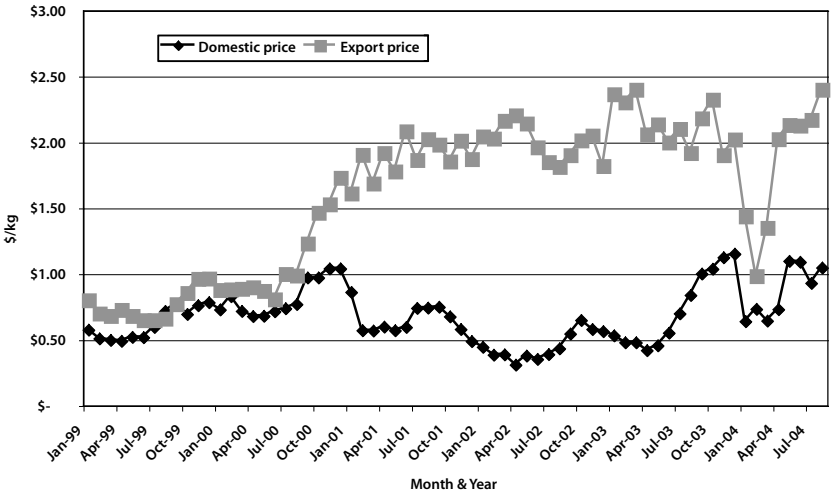
Data Source: USDA-FAS, USDA-AMS, Kansas State University

Figure 3.2. *Domestic Cattle Heart Prices vs. Frozen Heart Imputed Export Prices Monthly, January 1999 – August 2004.*



Data Source: USDA-FAS, USDA-AMS, Kansas State University

Figure 3.3. *Domestic Beef Tripe Prices vs. Frozen, Imputed Exported Tripe Prices Monthly, January 1999 – August 2004 .*



Data Source: USDA-FAS, USDA-AMS, Kansas State University

was spread across virtually all products. For example, exports of fresh boneless beef, frozen boneless beef, and bone-in frozen beef, which accounted for 68 percent of exports during 2003, declined 84, 96, and 97 percent, respectively during 2004. In fact, a review of the top nine beef export categories from 2003 reveals large export declines during 2004 were the norm. Beef tripe exports declined 47 percent, edible offal shipments were down 88 percent, fresh, boneless, processed beef cut exports were off 38 percent, frozen tongue exports declined 96 percent, prepared or preserved offal product shipments declined 57 percent, liver exports fell 60 percent and fresh bone-in beef cut exports declined 96 percent, all compared to the prior year.

Table 3.2 reports the change in export quantities from 2003 to 2004. Percentage declines in the quantity of various beef products exported were similar, but not identical, to the value changes reported in Table 3.1. The fact that the percentage changes are similar indicates that imputed prices (value of product exported divided by quantity of product exported) of exported beef products did not change appreciably from 2003 to 2004.

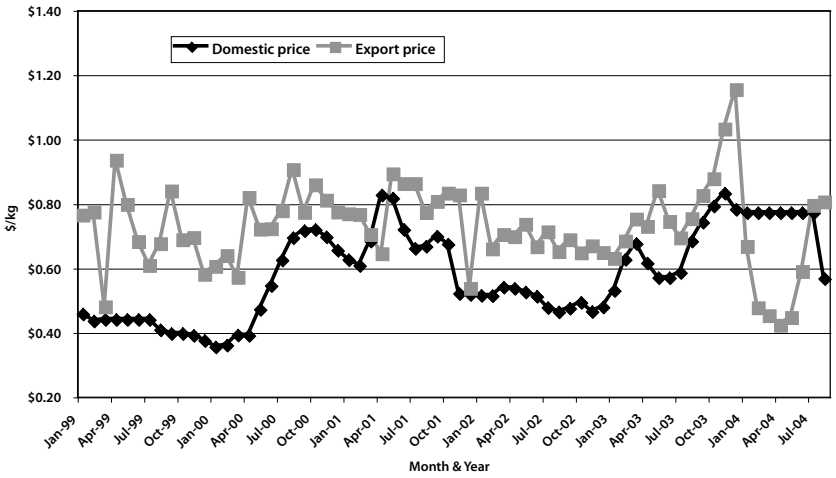
Figures 3.1 through 3.4 compare prices of various domestic beef cuts with imputed export prices for equivalent (or near equivalent) export categories. Domestic prices were obtained from the Livestock Marketing Information Center (LMIC) and were collected and originally published by the USDA Agricultural Marketing Service. Imputed prices were calculated by dividing the value of a particular export category by the quantity exported of the same category. The graphs illustrate the relationship between reported domestic prices and estimated export prices.

Figure 3.1 presents the imputed export prices for frozen tongues versus the USDA reported domestic price. Horizontal lines at a particular price level generally indicate no new trade was reported by USDA and, hence, USDA continued to publish the last reported price for an extended period of time. The lack of domestic price data suggests that the domestic tongue market is relatively thin, which is partially attributable to the fact that a high percentage of production is exported. Note that the graph indicates export prices

Table 3.2. *U.S. Beef and By-product Export Quantities.*

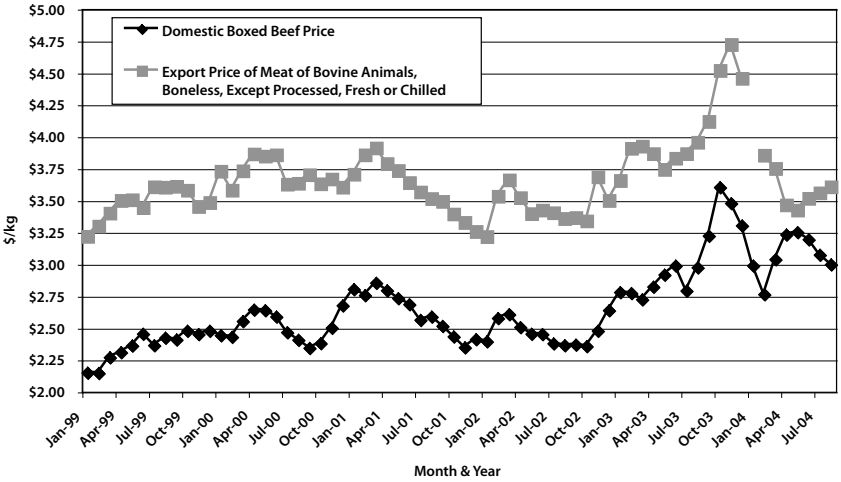
Category	Quantities in Metric Tons (unless otherwise noted.)			Difference 03-04	Percentage Change
	2003	Jan-Aug 03	Jan-Aug 04		
Meat of Bovine Animals, Boneless, Fresh or Chilled (Does not include processed items)	359,530	259,780	43,665	(216,115)	-83.2%
Meat of Bovine Animals, Boneless, Frozen (Does not include processed items)	269,054	178,625	6,732	(171,893)	-96.2%
Meat of Bovine Animals, Cuts With Bone In, Frozen (Does not include processed items)	96,929	62,893	918	(61,976)	-98.5%
Beef Tripe, Frozen	119,225	77,211	42,814	(34,397)	-44.6%
Other Edible Offal of Bovine Animals, Frozen	117,818	82,160	14,288	(67,872)	-82.6%
Meat of Bovine Animals, Fresh or Chilled, Boneless, Processed	45,000	30,564	16,123	(14,441)	-47.2%
Tongues of Bovine Animals, Edible, Frozen	27,331	18,862	1,581	(17,281)	-91.6%
Meat or Meat Offal of Bovine Animals, NESOI, Prepared or Preserved	24,009	13,639	4,461	(9,178)	-67.3%
Livers of Bovine Animals, Edible, Frozen	90,541	61,085	29,513	(31,572)	-51.7%
Meat of Bovine Animals, Cuts with Bone In, Fresh or Chilled (Does not include processed items)	18,906	13,647	411	(13,236)	-97.0%
Bovine Semen (unit)	7,822,178	4,889,620	5,319,499	429,879	8.8%
Meat of Bovine Animals, Frozen, Boneless, Processed	11,407	7,137	4,019	(3,118)	-43.7%
Bovine Animals, Live, NESOI (head)	81,078	65,832	25,113	(40,719)	-61.9%
Meat of Bovine Animals, Frozen, Other Cuts With Bone In, Processed	11,575	7,791	928	(6,863)	-88.1%
Guts, Bladders and Stomachs of Animals; Beef Intestine Frozen	15,475	11,518	219	(11,299)	-98.1%
Lips of Bovine Animals, Frozen	16,540	11,235	2,824	(8,411)	-74.9%
Bovine Animals, Live, Purebred Breeding, Dairy, Female (head)	8,740	5,635	129	(5,506)	-97.7%
Offal of Bovine Animals, Edible, Fresh or Chilled	7,524	4,455	866	(3,589)	-80.6%
Meat of Bovine Animals, Fresh or Chilled, Other Cuts with Bone In, Processed	4,477	2,521	334	(2,187)	-86.8%
Hearts of Bovine Animals, Frozen	17,150	12,036	5,712	(6,325)	-52.5%
Meat of Bovine Animals, Salted, In Brine, Dried or Smoked	1,256	886	95	(792)	-89.3%
Carcasses and Half-carcasses of Bovine Animals, NESOI, Fresh or Chilled	1,355	969	258	(711)	-73.4%
Carcasses and Half-carcasses of Bovine Animals, NESOI, Frozen	1,388	947	366	(581)	-61.3%
Dairy Cattle Embryos (number of embryos)	5,861	3,487	3,883	396	11.4%
Bovine Animals, Live, Purebred Breeding, Dairy, Male (head)	3,906	2,575	35	(2,540)	-98.6%
Bovine Animals, Live, Purebred Breeding, Except Dairy, Female (head)	2,565	1,868	38	(1,830)	-98.0%
Bovine Animals, Live, Purebred Breeding, Except Dairy, Male (head)	2,529	2,005	22	(1,983)	-98.9%
Carcasses and Half-carcasses of Veal, Fresh or Chilled	804	734	60	(674)	-91.8%
Kidneys of Bovine Animals, Frozen	3,549	2,374	2,278	(97)	-4.1%
Cattle Embryos, Except Dairy Cattle (number of embryos)	2,497	1,460	2,768	1,308	89.6%
Carcasses and Half-carcasses of Veal, Frozen	191	125	62	(63)	-50.1%
Sweetbreads of Bovine Animals, Frozen	582	432	58	(374)	-86.6%
Brains of Bovine Animals, Frozen	192	113	282	169	149.7%

Figure 3.4. *Domestic Beef Liver Prices vs. Frozen, Imputed Exported Liver Prices Monthly, January 1999 – August 2004.*



Data Source: USDA-FAS, USDA-AMS, Kansas State University

Figure 3.5. *U.S. Weighted Average Boxed Beef Price vs. Fresh Boneless Beef Imputed Export Price Monthly, January 1999 – August 2004.*



Data Source: USDA-FAS, LMIC, Kansas State University

for frozen tongues are often below domestic prices. This is counterintuitive because export prices are expected to be higher than the domestic prices, thereby providing an incentive to export. However, this price difference might be attributable to the fact that the exported tongue prices are for frozen tongues and the domestic tongue price reports include fresh tongues. Unfortunately, fresh tongues are included in an export category that also contains a multitude of other meat products, making it impossible to calculate a fresh-tongue export price for comparison with the domestic price series. Interviews with industry representatives suggest that data on exported fresh tongue is minimal since nearly all exported tongues are frozen.

Frozen cattle hearts for export generally trade at a premium to domestic cattle hearts (Figure 3.2). During 2004, export prices dipped below domestic prices for 2 months before rising above the domestic price during the spring as the United States regained access to some export markets.

Imputed export and domestic beef tripe prices were similar in 1999 (Figure 3.3). Subsequently the premium for exported tripe widened substantially, suggesting the export market was more attractive for processors than the domestic market. Note that imputed export tripe prices lost most of their premium over domestic prices in early 2004. Values recovered substantially in late spring 2004 as the United States reentered some export markets. In particular, reentry into the Mexican market was particularly important as Mexico accounted for 22 percent of tripe exports during 2003.

Imputed export prices for liver generally exhibit a premium relative to domestic prices (Figure 3.4). Note that in early 2004, export prices were markedly lower than domestic prices. By late spring, however, export prices recovered and were again above domestic prices. However, both domestic and exported livers were trading at a substantially lower value than before the export ban.

Imputed export prices for fresh, boneless beef are compared with the weighted average USDA boxed beef cutout value in Figure 3.5. The weighted average of USDA's Choice and Select boxed beef cutouts (weighted by the percentage of slaughter volume in each quality grade) was chosen for comparison because it represents an average value for all beef cuts. Similarly, imputed prices for fresh, boneless beef exports also represent an average value for a variety of beef cuts. Statistical analysis revealed that movement in one price series was highly correlated with the other. The correlation coefficient for the two data series from 1999 through 2003 was 0.89, indicating that the two series nearly move in tandem. This was consistent with the 2004 experience. As export values declined in early 2004, so did domestic boxed beef values, although domestic market values recovered more quickly than did

Table 3.3. *U.S. Beef and By-product Exports, By Category, January-August 2004.*

Category	Percent Change in Value from 2003 Month							
	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04	Jul-04	Aug-04
Meat of Bovine Animals, Boneless, Fresh or Chilled (Does not include processed items)	-98.7%	-98.4%	-90.6%	-85.9%	-83.4%	-78.8%	-74.7%	-72.4%
Meat of Bovine Animals, Boneless, Frozen (Does not include processed items)	-96.1%	-96.0%	-94.5%	-94.5%	-95.6%	-96.1%	-95.8%	-96.4%
Meat of Bovine Animals, Cuts with Bone In, Frozen (Does not include processed items)	-91.9%	-94.8%	-96.9%	-97.4%	-96.6%	-98.2%	-99.4%	-98.9%
Beef Tripe, Frozen	-93.6%	-92.1%	-76.8%	-36.0%	-29.0%	-48.1%	-14.6%	10.4%
Other Edible Offal of Bovine Animals, Frozen	-93.7%	-91.8%	-90.5%	-92.0%	-79.0%	-83.3%	-85.6%	-89.8%
Meat of Bovine Animals, Fresh or Chilled, Boneless, Processed	-85.4%	-87.4%	-47.4%	0.8%	-27.3%	-44.7%	-44.2%	-0.9%
Tongues of Bovine Animals, Edible, Frozen	-97.3%	-98.5%	-100.0%	-98.5%	-92.2%	-92.3%	-94.5%	-95.4%
Meat or Meat Offal of Bovine Animals, NESOI, Prepared or Preserved	-82.8%	-65.2%	-40.1%	-46.9%	-59.4%	-51.6%	-60.4%	-48.9%
Livers of Bovine Animals, Edible, Frozen	-72.5%	-74.8%	-76.7%	-70.8%	-72.0%	-65.7%	-37.6%	-3.1%
Meat of Bovine Animals, Cuts with Bone In, Fresh or Chilled (Does not include processed items)	-99.2%	-98.8%	-98.5%	-99.4%	-97.7%	-94.7%	-92.8%	-89.2%
Bovine Semen	-9.3%	25.8%	1.6%	6.7%	3.7%	9.7%	8.9%	-7.6%
Meat of Bovine Animals, Frozen, Boneless, Processed	-73.1%	-55.9%	-54.2%	-54.4%	9.1%	-44.7%	-48.0%	-42.9%
Bovine Animals, Live, NESOI	-81.7%	-100.0%	-100.0%	-96.3%	-60.9%	-61.7%	-44.9%	-83.6%
Meat of Bovine Animals, Frozen, Other Cuts with Bone In, Processed	-92.8%	-89.9%	-81.6%	-65.3%	-78.9%	-83.3%	-78.4%	-92.7%
Guts, Bladders and Stomachs of Animals; Beef Intestine Frozen	-97.3%	-100.0%	-96.8%	-98.7%	-98.6%	-97.0%	-96.5%	-98.6%
Lips of Bovine Animals, Frozen	-99.1%	-82.7%	-93.2%	-97.1%	-29.5%	-19.5%	-44.5%	-34.1%
Bovine Animals, Live, Purebred Breeding, Dairy, Female	-100.0%	-100.0%	-100.0%	-100.0%	-90.0%	-81.7%	-93.4%	-99.3%
Offal of Bovine Animals, Edible, Fresh or Chilled	-79.9%	-64.4%	-90.0%	-87.1%	-77.7%	-73.6%	-80.1%	-83.1%
Meat of Bovine Animals, Fresh or Chilled, Other Cuts with Bone In, Processed	-70.7%	-32.0%	-64.5%	-69.8%	-77.5%	-89.8%	-94.1%	-96.5%
Hearts of Bovine Animals, Frozen	-83.5%	-87.5%	-69.9%	-23.0%	-0.2%	-41.3%	-43.0%	-45.5%
Meat of Bovine Animals, Salted, In Brine, Dried or Smoked	-90.4%	-97.3%	-94.1%	-99.3%	-98.6%	-95.3%	-72.9%	-97.1%
Carcasses and Half-carcasses of Bovine Animals, NESOI, Fresh or Chilled	-80.1%	-55.4%	-90.2%	-100.0%	-83.0%	-98.8%	-96.5%	-77.4%
Carcasses and Half-carcasses of Bovine Animals, NESOI, Frozen	-85.9%	-92.0%	-91.3%	-73.2%	-34.3%	-77.1%	-39.5%	-65.6%
Dairy Cattle Embryos	-78.2%	15.2%	-22.9%	81.4%	143.9%	-10.1%	149.8%	-14.0%
Bovine Animals, Live, Purebred Breeding, Dairy, Male	-90.7%	-100.0%	-100.0%	-91.0%	-100.0%	-98.8%	-100.0%	-100.0%
Bovine Animals, Live, Purebred Breeding, Except Dairy, Female	26.7%	-100.0%	-100.0%	-100.0%	-100.0%	-100.0%	-100.0%	-100.0%
Bovine Animals, Live, Purebred Breeding, Except Dairy, Male	-100.0%	-100.0%	-98.8%	-100.0%	-100.0%	-100.0%	-100.0%	-98.9%
Carcasses and Half-carcasses of Veal, Fresh or Chilled	-94.4%	-96.4%	-100.0%	-100.0%	-87.4%	-51.1%	-48.3%	-83.3%
Kidneys of Bovine Animals, Frozen	4.9%	4.8%	82.7%	114.1%	41.2%	-36.3%	77.5%	-46.5%
Cattle Embryos, Except Dairy Cattle	-58.5%	-100.0%	14.1%	182.1%	400.9%	162.3%	118.4%	196.0%
Carcasses and Half-carcasses of Veal, Frozen	-89.8%	-100.0%	-93.5%	-74.0%	102.4%	-93.7%	-100.0%	-88.5%
Sweetbreads of Bovine Animals, Frozen	-100.0%	-72.7%	-100.0%		-100.0%	-100.0%	-60.0%	-100.0%
Brains of Bovine Animals, Frozen	-100.0%	384.6%	-100.0%	-59.6%	1062.5%	16.7%		26.7%

export values.

Table 3.3 illustrates the percentage change in beef export value by month for January through August 2004, relative to January through August 2003. As 2004 progressed various countries, such as Mexico, lifted their bans on U.S. beef. The modest export recovery was not spread equally across all products. For example, fresh boneless beef exports were down 99 percent during January, but recovered by August to 72 percent below the previous year. Beef tripe exports were 94 percent below 2003 during January, but were actually 10 percent above the prior year in August. However, other important beef export categories showed virtually no recovery as the year progressed. Two important examples are frozen, boneless beef, which were still down 96 percent compared to the prior year in August, and frozen, bone-in beef exports, which were 99 percent below 2003 during August 2004. Bone-in exports in particular did not recover during 2004 as most importers that did relax restrictions on U.S. beef restricted imports to boneless products.

3.4 U.S. Beef Export Customers

Table 3.4 provides a dollar value ranking, by country, of beef export shipments during 2003. Five countries, Japan, Mexico, South Korea, Canada, and Hong Kong, were the recipients of 90 percent of U.S .beef exports during 2003, based on value. Japan, historically the largest U.S. beef export customer, represented 35 percent of U.S. beef exports during 2003. Japan's relative importance as an importer has declined in recent years. U.S. beef exports to Japan totaled $1.4 billion during 2003, down from $1.8 billion during 2000. The biggest decline occurred following Japan's discovery of BSE in the Japanese herd in late 2001 and continued in 2002. Exports to Japan began to recover during 2003. At the same time exports to Japan were declining, exports to Mexico and South Korea were growing. Mexico's share of U.S. exports during 2000 was 18 percent, but grew to 23 percent during 2003. Similarly, South Korea's share of U.S. beef exports was 13 percent during 2000, but reached 21 percent during 2003. Canada's share of the U.S. beef export market has declined modestly, falling from 12 percent during 2000 to 9 percent during 2003. Interestingly, the only major importers of U.S. beef since December 2003 have been the U.S. NAFTA trading partners, Mexico and Canada. As a result, Mexico's share of U.S. beef exports skyrocketed to 64 percent during 2004, while Canada's share held steady at 10 percent. Although Canada's share of total U.S. exports held steady during 2004, total exports of U.S. beef to Canada were still 81 percent below the prior year's reflecting Canada's ongoing struggle with their BSE related loss of beef exports.

3.5 Beef Exports, By Country, and Category

Japan

Tables 3.4.1 through 3.4.5 summarize beef exports for the top five U.S. beef importers (Japan, Mexico, S. Korea, Canada, and Hong Kong), by product category. Japan's market share of the five most important U.S. beef export categories during 2003 were: fresh, boneless beef, 47 percent; frozen, boneless beef, 44 percent; frozen, bone-in beef, 9 percent; beef tripe, 13 percent; frozen edible offal, 40 percent.

The loss of a large market (such as Japan) can have significantly different effects on the U.S. market relative to smaller importers. The inability to access the Japanese market meant the United States lost an important customer for key export products such as fresh and frozen boneless and frozen bone-in beef. Japan was also an important customer for specialty items such as frozen tongues, frozen guts, bladders and stomachs, and beef intestines and fresh or chilled edible beef offal. In particular, Japan was an important market for beef tongues, accounting for 79 percent of the value of all U.S. tongue exports during 2003. There does not appear to be any serious domestic or international alternative market for many of these products. For example, the next largest beef tongue customer was South Korea, with an 8 percent market share. As of first quarter 2005, beef trade with Japan had not been restored. Comparing export data from January through August 2004 with data from January through August 2003 indicates that the loss of the Japanese beef market accounted for an export value loss of $906 million.

Table 3.4 *Beef Exports, by Country.*

Country	Value in Thousand of Dollars			Percentage of Total Export Value			Difference 2003-2004	2003 Cumulative	% Change in Value
	2003	Jan-Aug 2003	Jan-Aug 2004	2003	Jan-Aug 2003	Jan-Aug 2004			
Japan	$1,396,970	$914,262	$7,280	35.4%	34.9%	1.5%	$(906,982)	35.4%	-99.2%
Mexico	$899,930	$605,525	$302,267	22.8%	23.1%	63.9%	$(303,258)	58.1%	-50.1%
Korea, Republic Of	$816,732	$556,539	$1,188	20.7%	21.2%	0.3%	$(555,351)	78.8%	-99.8%
Canada	$350,119	$255,944	$48,582	8.9%	9.8%	10.3%	$(207,362)	87.7%	-81.0%
Hong Kong	$90,795	$43,088	$447	2.3%	1.6%	0.1%	$(42,641)	90.0%	-99.0%
Taiwan	$76,761	$46,389	$568	1.9%	1.8%	0.1%	$(45,821)	91.9%	-98.8%
Russian Federation	$53,226	$32,699	$406	1.3%	1.2%	0.1%	$(32,293)	93.2%	-98.8%
China, Peoples Republic	$33,414	$20,782	$2,016	0.8%	0.8%	0.4%	$(18,766)	94.1%	-90.3%
Kuwait	$26,800	$10,727	$3,188	0.7%	0.4%	0.7%	$(7,539)	94.8%	-70.3%
Egypt	$26,576	$16,628	$147	0.7%	0.6%	0.0%	$(16,481)	95.4%	-99.1%
Indonesia	$15,287	$7,863	$7,776	0.4%	0.3%	1.6%	$(87)	95.8%	-1.1%
Saudi Arabia	$11,960	$8,839	$6,428	0.3%	0.3%	1.4%	$(2,411)	96.1%	-27.3%
Bahamas, The	$11,636	$7,330	$10,140	0.3%	0.3%	2.1%	$2,810	96.4%	38.3%
United Arab Emirates	$8,959	$4,839	$1,925	0.2%	0.2%	0.4%	$(2,914)	96.6%	-60.2%
Switzerland	$8,099	$5,052	$4,980	0.2%	0.2%	1.1%	$(72)	96.9%	-1.4%
Bermuda	$6,991	$4,751	$5,465	0.2%	0.2%	1.2%	$714	97.0%	15.0%
Germany	$6,251	$3,630	$5,213	0.2%	0.1%	1.1%	$1,583	97.2%	43.6%
Singapore	$5,868	$3,651	$68	0.1%	0.1%	0.0%	$(3,583)	97.3%	-98.1%
Netherlands	$4,937	$2,937	$3,199	0.1%	0.1%	0.7%	$262	97.5%	8.9%
Philippines	$4,913	$3,295	$3,040	0.1%	0.1%	0.6%	$(255)	97.6%	-7.7%
United Kingdom	$4,690	$2,994	$4,027	0.1%	0.1%	0.9%	$1,033	97.7%	34.5%
Dominican Republic	$4,616	$2,967	$875	0.1%	0.1%	0.2%	$(2,092)	97.8%	-70.5%
Jamaica	$4,374	$3,164	$79	0.1%	0.1%	0.0%	$(3,085)	97.9%	-97.5%
Guatemala	$4,167	$2,723	$710	0.1%	0.1%	0.2%	$(2,013)	98.0%	-73.9%
Other Countries	$77,568	$53,083	$53,288	2.0%	2.0%	11.3%	$205	100.0%	0.4%
Total	$3,951,639	$2,619,701	$473,302				$(2,146,399)		-81.9%

Mexico

Beef exports to Mexico totaled about $900 million during 2003, making it the second largest U.S. customer. As mentioned previously, Mexico is an important market outlet for fresh boneless beef and beef tripe. In addition, Mexico is a key market for several minor export categories including fresh, boneless, processed beef, (80 percent of U.S. exports) and frozen beef lips (nearly 100 percent of U.S. exports). Exports of fresh, boneless, processed beef to Mexico totaled $132 million in 2003 while exports of frozen lips totaled $23.2 million. Following the reopening of the Mexican market in April 2004, exports recovered substantially. Still, total exports to Mexico from January through August 2004 were down $303 million compared to 2003.

Mexico imports a different mix of U.S. beef products than does Japan. Its share of U.S. exports among the top five beef export categories during 2003 were as follows: fresh, boneless beef, 28 percent; frozen, boneless beef, 2 percent; frozen, bone-in beef, 1 percent; beef tripe, 77 percent; frozen, edible offal, 19 percent. While Mexico was a much smaller beef export customer than Japan, it was a more important customer for some lower valued products such as beef tripe.

South Korea

South Korea imported $816 million worth of U.S. beef products during 2003, making it the third largest U.S. beef customer.

Table 3.4.1 *Beef and By-product Exports to Japan, by Category.*

Category	Exports Value (Thousand Dollars)			Japanese Share of Total U.S. Exports, by Product Category			Jan-Aug Value Change from 2003 to 2004	Jan-Aug % Change in Value from 2003 to 2004	% of Total Exports to Japan in 2003	Cumulative Percentage of Exports to Japan in 2003
	2003	Jan-Aug 03	Jan-Aug 04	2003	Jan-Aug 03	Jan-Aug 04				
Meat of Bovine Animals, Boneless, Fresh or Chilled (Does not include processed items)	$680,275	$466,030	$179	47.18%	46.65%	0.12%	$(465,851)	-100.0%	48.7%	48.7%
Meat of Bovine Animals, Boneless, Frozen (Does not include processed items)	$402,750	$245,356	$96	43.89%	41.75%	0.38%	$(245,260)	-100.0%	28.8%	77.5%
Tongues of Bovine Animals, Edible, Frozen	$83,561	$52,128	$4	79.11%	77.62%	0.14%	$(52,124)	-100.0%	6.0%	83.5%
Other Edible Offal of Bovine Animals, Frozen	$78,188	$49,487	$2,484	39.74%	38.50%	16.02%	$(47,003)	-95.0%	5.6%	89.1%
Beef Tripe, Frozen	$32,861	$20,139	$0	12.90%	12.16%	0.00%	$(20,139)	-100.0%	2.4%	91.5%
Meat of Bovine Animals, Cuts with Bone In, Frozen (Does not include processed items)	$30,385	$18,488	$0	8.87%	8.43%	0.00%	$(18,488)	-100.0%	2.2%	93.6%
Meat of Bovine Animals, Fresh or Chilled, Boneless, Processed	$17,442	$13,565	$0	10.61%	13.15%	0.00%	$(13,565)	-100.0%	1.2%	94.9%
Guts, Bladders and Stomachs of Animals; Beef Intestine Frozen	$16,162	$11,407	$0	60.21%	57.95%	0.00%	$(11,407)	-100.0%	1.2%	96.0%
Meat of Bovine Animals, Cuts with Bone In, Fresh or Chilled (Does not include processed items)	$12,937	$10,363	$0	18.07%	19.48%	0.00%	$(10,363)	-100.0%	0.9%	97.0%
Offal of Bovine Animals, Edible, Fresh or Chilled	$9,278	$5,053	$0	57.36%	57.91%	0.00%	$(5,053)	-100.0%	0.7%	97.6%
Meat of Bovine Animals, Salted, In Brine, Dried or Smoked	$7,373	$4,637	$0	69.37%	66.95%	0.00%	$(4,637)	-100.0%	0.5%	98.2%
Other	$25,758	$17,609	$4,517				$(13,092)	-74.3%	1.8%	100.0%
Total	$1,396,970	$914,262	$7,280				$(906,982)	-99.2%		

Table 3.4.2. *Beef and By-product Exports to Mexico, by Category.*

Category	Exports Value (Thousand Dollars)			Mexican Share of Total U.S. Exports, by Product Category			Jan-Aug Value Change from 2003 to 2004	Jan-Aug % Change in Value from 2003 to 2004	% of Total Exports to Mexico in 2003	Cumulative Percentage of Exports to Mexico in 2003
	2003	Jan-Aug 03	Jan-Aug 04	2003	Jan-Aug 03	Jan-Aug 04				
Meat of Bovine Animals, Boneless, Fresh or Chilled (Does not include processed items)	$399,757	$282,897	$130,197	27.73%	28.32%	83.68%	$(152,700)	-54.0%	44.4%	44.4%
Beef Tripe, Frozen	$196,193	$131,504	$78,782	76.99%	79.42%	89.05%	$(52,722)	-40.1%	21.8%	66.2%
Meat of Bovine Animals, Fresh or Chilled, Boneless, Processed	$131,505	$80,195	$57,290	79.97%	77.72%	89.86%	$(22,905)	-28.6%	14.6%	80.8%
Other Edible Offal of Bovine Animals, Frozen	$37,433	$24,719	$7,069	19.03%	19.23%	45.58%	$(17,650)	-71.4%	4.2%	85.0%
Lips of Bovine Animals, Frozen	$23,243	$14,996	$5,934	99.92%	99.88%	99.66%	$(9,062)	-60.4%	2.6%	87.6%
Meat of Bovine Animals, Cuts with Bone In, Fresh or Chilled (Does not include processed items)	$21,321	$14,207	$28	29.78%	26.71%	1.25%	$(14,179)	-99.8%	2.4%	89.9%
Meat of Bovine Animals, Boneless, Frozen (Does not include processed items)	$17,589	$10,985	$6,065	1.92%	1.87%	23.90%	$(4,920)	-44.8%	2.0%	91.9%
Meat of Bovine Animals, Frozen, Boneless, Processed	$10,993	$6,217	$5,358	31.13%	29.01%	45.95%	$(859)	-13.8%	1.2%	93.1%
Meat of Bovine Animals, Fresh or Chilled, Other Cuts with Bone In, Processed	$10,603	$5,657	$21	79.17%	82.20%	1.94%	$(5,636)	-99.6%	1.2%	94.3%
Bovine Animals, Live, NESOI	$10,330	$7,706	$536	30.46%	28.43%	12.87%	$(7,170)	-93.1%	1.1%	95.4%
Bovine Animals, Live, Purebred Breeding, Dairy, Female	$6,932	$3,601	$33	38.04%	26.23%	9.73%	$(3,568)	-99.1%	0.8%	96.2%
Bovine Semen	$5,161	$3,036	$3,330	11.19%	10.05%	10.52%	$294	9.7%	0.6%	96.8%
Livers of Bovine Animals, Edible, Frozen	$3,917	$2,548	$919	5.44%	5.75%	5.12%	$(1,629)	-63.9%	0.4%	97.2%
Meat of Bovine Animals, Cuts with Bone In, Frozen (Does not include processed items)	$3,646	$2,298	$18	1.06%	1.05%	0.29%	$(2,280)	-99.2%	0.4%	97.6%
Tongues of Bovine Animals, Edible, Frozen	$3,241	$2,843	$2,558	3.07%	4.23%	88.63%	$(285)	-10.0%	0.4%	98.0%
Other	$18,066	$12,116	$4,129				$(7,987)	-65.9%	2.0%	100.0%
Total	$899,930	$605,525	$302,267				$(303,258)	-50.1%		

Table 3.4.3. *Beef and By-product Exports to South Korea, by Category.*

Category	Exports Value (Thousand Dollars)			South Korean Share of Total U.S. Exports, by Product Category			Jan-Aug Value Change from 2003 to 2004	Jan-Aug % Change in Value from 2003 to 2004	% of Total Exports to South Korea in 2003	Cumulative Percentage of Exports to South Korea in 2003
	2003	Jan-Aug 03	Jan-Aug 04	2003	Jan-Aug 03	Jan-Aug 04				
Meat of Bovine Animals, Boneless, Frozen (Does not include processed items)	$331,857	$237,088	$162	36.17%	40.35%	0.64%	$(236,926)	-99.9%	40.6%	40.6%
Meat of Bovine Animals, Cuts with Bone In, Frozen (Does not include processed items)	$264,114	$175,470	$163	77.14%	80.00%	2.60%	$(175,307)	-99.9%	32.3%	73.0%
Meat of Bovine Animals, Boneless, Fresh or Chilled (Does not include processed items)	$114,971	$76,057	$0	7.97%	7.61%	0.00%	$(76,057)	-100.0%	14.1%	87.1%
Other Edible Offal of Bovine Animals, Frozen	$37,279	$25,323	$25	18.95%	19.70%	0.16%	$(25,298)	-99.9%	4.6%	91.6%
Meat of Bovine Animals, Frozen, Other Cuts with Bone In, Processed	$19,762	$13,614	$0	72.78%	77.29%	0.00%	$(13,614)	-100.0%	2.4%	94.0%
Beef Tripe, Frozen	$11,425	$6,099	$72	4.48%	3.68%	0.08%	$(6,027)	-98.8%	1.4%	95.4%
Meat or Meat Offal of Bovine Animals, NESOI, Prepared or Preserved	$8,596	$2,339	$64	10.17%	4.60%	0.29%	$(2,275)	-97.3%	1.1%	96.5%
Tongues of Bovine Animals, Edible, Frozen	$8,129	$6,628	$0	7.70%	9.87%	0.00%	$(6,628)	-100.0%	1.0%	97.5%
Guts, Bladders and Stomachs of Animals; Beef Intestine Frozen	$6,687	$5,275	$0	24.91%	26.80%	0.00%	$(5,275)	-100.0%	0.8%	98.3%
Other	$13,912	$8,646	$702				$(7,944)	-91.9%	1.7%	100.0%
Total	$816,732	$556,539	$1,188				$(555,351)	-99.8%		

Following the December 2003 BSE announcement, U.S. beef exports to South Korea totaled just $1 million during the first 8 months of 2004. Ninety-two percent of South Korea's U.S. beef imports were concentrated primarily in four categories: frozen boneless beef, frozen bone-in beef, fresh boneless beef, and frozen edible offal. South Korea was a particularly important market for frozen bone-in beef, accounting for 77 percent of U.S. exports in that category in 2003. During the first 8 months of 2004, U.S. exports to South Korea of those four product categories totaled just $350,000.

Canada

Canada, the fourth largest U.S. beef export market, imported about $350 million of beef products in 2003. Canada accounted for 73 percent and 69 percent, respectively, of U.S. exports of prepared or preserved beef offal and live cattle. From January through August 2004, U.S. beef exports fell about 81 percent below 2003's level. Nonetheless, Canada was one of just two of the top five export markets for U.S. beef (based on 2003 trade) that imported a significant amount of U.S. beef and beef products in 2004.

Hong Kong

Hong Kong was the fifth largest U.S. beef importer in 2003, with imports valued at $90 million. In comparison, the value of exports to Japan and Mexico were approximately 15 and 10 times as large, respectively. Similar to the other Asian countries discussed previously, Hong Kong's U.S. beef imports were almost nonexistent in 2004 (only 1 percent of 2003 import levels). The two largest import categories

Table 3.4.4. *Beef and By-product Exports to Canada, by Category.*

Category	Exports Value (Thousand Dollars)			Canadian Share of Total U.S. Exports, by Product Category			Jan-Aug Value Change from 2003 to 2004	Jan-Aug % Change in Value from 2003 to 2004	% of Total Exports to Canada in 2003	Cumulative Percentage of Exports to Canada in 2003
	2003	Jan-Aug 03	Jan-Aug 04	2003	Jan-Aug 03	Jan-Aug 04				
Meat of Bovine Animals, Boneless, Fresh or Chilled (Does not include processed items)	$201,448	$147,165	$17,051	13.97%	14.73%	10.96%	$(130,114)	-88.4%	57.5%	57.5%
Meat or Meat Offal of Bovine Animals, NESOI, Prepared or Preserved	$62,015	$40,402	$18,951	73.40%	79.43%	85.70%	$(21,451)	-53.1%	17.7%	75.3%
Meat of Bovine Animals, Cuts with Bone In, Fresh or Chilled (Does not include processed items)	$25,010	$20,875	$1,877	34.93%	39.24%	83.72%	$(18,998)	-91.0%	7.1%	82.4%
Bovine Animals, Live, NESOI	$23,359	$19,181	$3,627	68.88%	70.76%	87.06%	$(15,554)	-81.1%	6.7%	89.1%
Meat of Bovine Animals, Boneless, Frozen (Does not include processed items)	$13,791	$9,279	$776	1.50%	1.58%	3.06%	$(8,503)	-91.6%	3.9%	93.0%
Other Edible Offal of Bovine Animals, Frozen	$6,047	$4,676	$2,122	3.07%	3.64%	13.68%	$(2,554)	-54.6%	1.7%	94.7%
Meat of Bovine Animals, Cuts with Bone In, Frozen (Does not include processed items)	$4,035	$3,794	$460	1.18%	1.73%	7.34%	$(3,334)	-87.9%	1.2%	95.9%
Bovine Semen	$3,863	$2,859	$2,416	8.38%	9.46%	7.63%	$(443)	-15.5%	1.1%	97.0%
Meat of Bovine Animals, Frozen, Boneless, Processed	$2,308	$1,507	$0	6.54%	7.03%	0.00%	$(1,507)	-100.0%	0.7%	97.6%
Livers of Bovine Animals, Edible, Frozen	$2,148	$1,476	$565	2.98%	3.33%	3.15%	$(911)	-61.7%	0.6%	98.3%
Other	$6,095	$4,730	$737				$(3,993)	-84.4%	1.7%	100.0%
Total	$350,119	$255,944	$48,582				$(207,362)	-81.0%		

Table 3.4.5. *Beef and By-product Exports to Hong Kong, by Category.*

Category	Exports Value (Thousand Dollars)			Hong Kong's Share of Total U.S. Exports, by Product Category			Jan-Aug Value Change from 2003 to 2004	Jan-Aug % Change in Value from 2003 to 2004	% of Total Exports to Hong Kong in 2003	Cumulative Percentage of Exports to Hong Kong in 2003
	2003	Jan-Aug 03	Jan-Aug 04	2003	Jan-Aug 03	Jan-Aug 04				
Meat of Bovine Animals, Boneless, Frozen (Does not include processed items)	$38,515	$17,732	$0	4.20%	3.02%	0.00%	$(17,732)	-100.0%	42.4%	42.4%
Meat of Bovine Animals, Cuts with Bone In, Frozen (Does not include processed items)	$16,361	$5,834	$0	4.78%	2.66%	0.00%	$(5,834)	-100.0%	18.0%	60.4%
Other Edible Offal of Bovine Animals, Frozen	$7,652	$5,208	$130	3.89%	4.05%	0.84%	$(5,078)	-97.5%	8.4%	68.9%
Beef Tripe, Frozen	$7,060	$3,441	$56	2.77%	2.08%	0.06%	$(3,385)	-98.4%	7.8%	76.6%
Meat of Bovine Animals, Boneless, Fresh or Chilled (Does not include processed items)	$5,384	$2,256	$0	0.37%	0.23%	0.00%	$(2,256)	-100.0%	5.9%	82.6%
Tongues of Bovine Animals, Edible, Frozen	$3,918	$2,117	$86	3.71%	3.15%	2.98%	$(2,031)	-95.9%	4.3%	86.9%
Meat of Bovine Animals, Fresh or Chilled, Boneless, Processed	$2,773	$1,496	$0	1.69%	1.45%	0.00%	$(1,496)	-100.0%	3.1%	89.9%
Guts, Bladders and Stomachs of Animals; Beef Intestine Frozen	$2,508	$2,118	$0	9.34%	10.76%	0.00%	$(2,118)	-100.0%	2.8%	92.7%
Meat of Bovine Animals, Frozen, Boneless, Processed	$1,812	$227	$0	5.13%	1.06%	0.00%	$(227)	-100.0%	2.0%	94.7%
Meat of Bovine Animals, Cuts with Bone In, Fresh or Chilled (Does not include processed items)	$1,383	$718	$0	1.93%	1.35%	0.00%	$(718)	-100.0%	1.5%	96.2%
Hearts of Bovine Animals, Frozen	$862	$533	$0	6.89%	6.37%	0.00%	$(533)	-100.0%	1.0%	97.2%
Carcasses and Half-carcasses of Bovine Animals, NESOI, Fresh or Chilled	$504	$216	$0	7.01%	4.29%	0.00%	$(216)	-100.0%	0.6%	97.7%
Meat of Bovine Animals, Fresh or Chilled, Other Cuts with Bone In, Processed	$470	$380	$76	3.51%	5.52%	7.03%	$(304)	-80.0%	0.5%	98.2%
Other	$1,593	$812	$99				$(713)	-87.8%	1.8%	100.0%
Total	$90,795	$43,088	$447				$(42,641)	-99.0%		

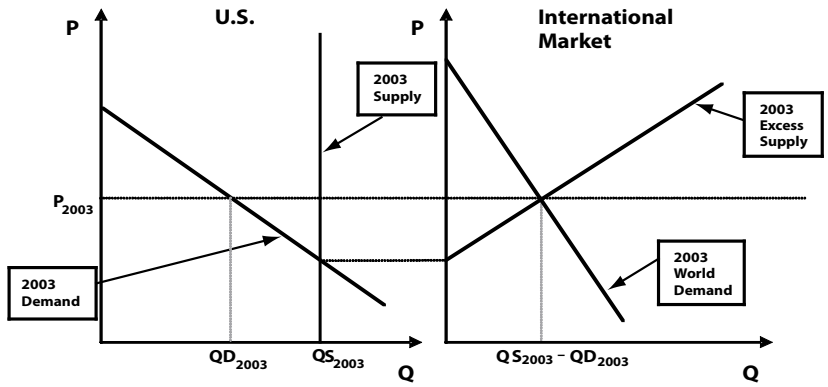
during 2003 were frozen, boneless beef and frozen, bone-in beef. Hong Kong's imports of these two categories totaled 4.2 percent and 4.8 percent, respectively, of U.S. exports.

3.6 Beef Industry Losses Attributable to the Trade Ban

Figure 3.6 illustrates a graphical model that is used to estimate U.S. beef industry losses as a result of import bans in 2004. The price/quantity graph on the left depicts short-run U.S. beef supply and demand relations that existed during 2003, prior to the Washington state BSE announcement. The domestic beef demand curve slopes down and to the right, indicating that U.S. consumers are willing and able to consume larger quantities of beef as price declines. The United States supply curve is depicted as a vertical line because it is assumed that the U.S. beef industry will not be able to significantly adjust the quantity of beef produced in the very short run. However, over a somewhat longer time period, production levels would adjust. The longer time period is required largely because of the long time lapse from conception to slaughter. The point where the supply and demand curves cross would determine the equilibrium price in the United States during 2003, if no exports were allowed.

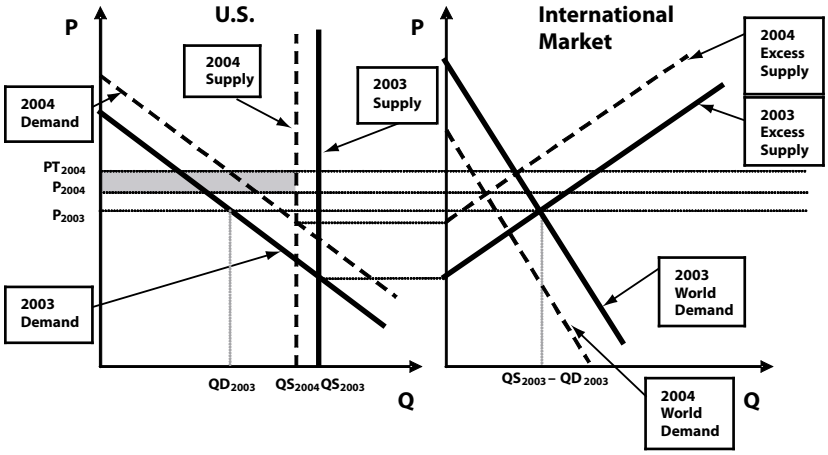
The price/quantity graph on the right of Figure 3.6 represents the international market where beef and beef by-products are traded. The United States is a significant beef exporter and supplies a variety of beef products to the rest of the world. To determine the vertical intercept of the U.S. excess supply curve (quantities of beef and prices at which the United States is willing and able to supply beef to the rest of the world) on the graph, a horizontal line is drawn from the intersection of the U.S. supply and demand curves in the left diagram, to the international market in the right diagram. The upward sloping line emanating from this point represents the U.S. excess supply curve in the international market. The excess supply curve is upward sloping, indicating that the United States is willing and able to supply larger quantities to the international market as price rises. At each price the quantity supplied to the export market represents the difference between domestic supply and demand at that price.

Figure 3.6. *U.S. and International Beef Markets.*



The downward sloping line depicts the 2003 world demand curve, indicating consumers in the rest of the world are willing and able to consume larger quantities of beef as price declines. The intersection of the international supply and demand curves determines the equilibrium quantity of U.S. beef demanded by international consumers and the equilibrium world market price, which feeds back into the U.S. market as P_{2003}. The intersection of this higher price level with the domestic demand curve determines the quantity demanded by domestic consumers, depicted as QD_{2003}. The difference between QS_{2003} and QD_{2003} is the quantity exported during 2003. Note that U.S. consumers purchase less, and pay a higher price for, beef than they would without exports. Note also that, in this analysis, we ignore shipping costs, which would result in slightly higher prices in the international market than in the U.S. market.

Figure 3.7. *Estimating U.S. Beef Industry Losses Due to Beef Export Reduction.*



3.7 Impact of Beef Export Reduction

Figure 3.7 is used to illustrate shocks that occurred in the beef industry in 2004. First, the U.S. beef supply curve shifted to the left since U.S. beef production was markedly smaller during 2004 than during 2003. The Livestock Marketing Information Center (LMIC) indicates that U.S. beef production during 2004 was approximately 6.4 percent smaller than during 2003. This is shown on the graph as a leftward shift of the U.S. supply curve to the dotted supply curve labeled *2004 Supply*. Second, domestic beef demand during 2004 was stronger than during 2003. Preliminary calculations of the domestic beef demand index indicate that domestic demand for U.S. Choice beef at retail increased about 7 percent to 8 percent compared to 2003 (Mintert). This is depicted as an upward shift of the domestic beef demand curve to the dotted line labeled *2004 Demand*. The intersection of the 2004 domestic supply and demand curves provides the origin for the 2004 excess supply curve in the international market. This excess supply curve is depicted in the international price/quantity diagram as a dotted line and labeled *2004 Excess Supply*. U.S. beef exports declined dramatically during 2004 as importers banned or severely restricted imports of U.S. beef. The reduction in export demand for U.S. beef during 2004 is incorporated in the model as a downward shift in international beef demand to the dotted line labeled *2004 World Demand*. The intersection of the *2004 World Demand* and the *2004 Excess Supply* curves yield the world equilibrium 2004 price, labeled P_{2004}, which was higher than P_{2003}. This is consistent with observed market behavior during 2004 since the annual average wholesale boxed beef cutout value during 2004 was about 1 percent higher than the 2003 average.

To determine losses associated with the BSE motivated trade disruption, consider what the equilibrium price in the world and domestic market would have been if *2004 World Demand* was the same as *2003 World Demand*. In this case, the international market equilibrium price would have been determined by the intersection of the *2004 Excess Supply* curve and the *2003 World Demand* curve, yielding PT_{2004}, which is higher than P_{2003}. Thus, the 2004 downward shift in *World Demand*, caused by import bans and restrictions, led to lower U.S. beef prices than would have otherwise occurred. The U.S. beef industry revenue loss is measured by the shaded rectangle, bounded by PT_{2004} and P_{2004} on the price axis of the U.S. graph.

Quantifying the revenue loss to the U.S. beef industry during 2004 required estimates of: a) U.S. beef production and b) how much higher domestic prices would have been if U.S. exports had not been restricted (i.e., PT_{2004} - P_{2004}). We used estimates of the own-price elasticity of beef demand[5] in the United States and in the international market to calculate PT_{2004}. Once PT_{2004} was computed, we took the difference between it and P_{2004} (the observed 2004 domestic beef price). This price differential multiplied by QS_{2004} (the quantity of beef produced in the United States during 2004) provides an estimate of the U.S. beef industry losses attributable to the BSE-related loss of exports. Appendix 4 provides a more detailed overview of this methodology.

U.S. commercial beef production estimates for 2003 (QS_{2003}) and 2004 (QS_{2004}) were obtained from LMIC, based upon USDA data. Commercial U.S. beef production totaled 26.3 billion pounds during 2003 and the preliminary estimate for 2004 was 24.6 billion pounds. Similarly, U.S. carcass-weight beef export estimates also were obtained from LMIC, based upon data reported by USDA. During 2003, U.S. carcass-weight beef exports, used to estimate QS_{2003}, totaled 2.5 billion pounds. The LMIC preliminary esti-

[5] *The own price elasticity of demand means the percentage change in quantity demanded corresponding to a one percent change in price.*

Table 3.5. *Impact of Carcass Beef Export Losses on U.S. Beef Industry, 2004.*

Rest of the World Own Price Demand Elasticity for U.S. Beef	U.S. Beef Own Price Demand Elasticity	Estimated 2004 Beef Price Without Export Market Losses ($/lb)	Estimated Beef Price Difference Attributable to Export Market Loss ($/lb)	Estimated U.S. Beef Industry Loss ($)
-2.00	-0.57	$1.54	$0.15	$3,597,776,864
-1.00	-0.57	$1.56	$0.17	$4,223,094,830
-2.00	-0.67	$1.52	$0.13	$3,189,698,172
-1.00	-0.67	$1.54	$0.15	$3,678,754,617
-2.00	-0.77	$1.51	$0.12	$2,864,761,878
-1.00	-0.77	$1.52	$0.13	$3,258,718,674

mate of U.S. beef exports during 2004, used to estimate QS_{2004}, was 483 million pounds.

Boxed beef cutout values published by the USDA Agricultural Marketing Service (AMS) were used as proxies for P_{2003} and P_{2004}. During 2003 and 2004, AMS published boxed beef cutout values for Choice and Select carcasses for two weight ranges. Annual light and heavy weight Choice cutout values were averaged to obtain Choice cutout values for 2003 and 2004. Similarly, annual light and heavy weight Select cutout values were averaged to obtain Select cutout values for 2003 and 2004. To determine the annual boxed beef cutout value across quality grades, a weighted-average cutout was computed. The weight assigned to the Choice cutout value equaled the percentage of cattle that graded Choice or higher (LMIC). The weight applied to the Select cutout value was one minus the percentage of cattle grading Choice or higher. Using this approach, the estimates for P_{2003} and P_{2004} were $137.60 per hundredweight and $139.20 per hundredweight, respectively.

Table 3.5 presents estimates of losses to the domestic beef industry associated with beef export losses during 2004. Two different international own-price beef demand elasticities, and three different domestic own-price demand elasticities, were employed to establish a range of likely losses. Purcell indicates that most domestic beef own-price elasticity estimates are near -0.67. Therefore, we used -0.67 as our initial domestic beef own-price elasticity estimate and we allowed the elasticity to vary by 0.1 in either direction. The resulting low and high elasticity estimates, -0.57 to -0.77, were used to ascertain how sensitive loss calculations were to the domestic own-price elasticity. Relatively little research has focused on the own-price elasticity for beef in the international market. However, Eenoo and Purcell indicated in a 2000 study that the own-price elasticity estimate for imported U.S. beef in Canada was -1.00, whereas in Japan it was -1.79. As a result, we employed international own price demand elasticity estimates of -2.0 and -1.0 to establish a range of likely losses. Using the international and domestic own-price beef elasticity estimates reveals that likely U.S. beef industry losses attributable to lost beef (carcass meat) exports during 2004 ranged from a low of $2.9 billion to a high of $4.2 billion.

3.8 Impact of Beef Offal Export Reduction

Beef industry revenue losses computed in the previous section exclude losses derived from reduced exports of beef offal. Beef offal is comprised of a number of different products. Not all offal products were affected by bans on U.S. imports. For example, beef tallow was not affected by the ban. The 12 FAS categories considered here are listed in Appendix 3. During 2003, the aggregate value of U.S. exports in these 12 categories was $795 million – 20 percent of the value of all U.S. beef and by-product exports.

The impact of reduced beef offal product exports on the beef industry was estimated using the same approach outlined in Figure 3.7. Thus, the objective was to estimate the area of the shaded rectangle using beef offal product prices and quantities. However, there were some differences. Offal production and price data were not readily available. As a result, U.S. offal production for 2003 and 2004 was estimated based on the number of cattle processed for slaughter and estimates of typical offal production per head. Several offal

Table 3.6 *Impact of Beef Offal Export Losses on U.S. Beef Industry, 2004.*

Rest of the World Own Price Demand Elasticity for U.S. Beef Offal	U.S. Beef Offal Own Price Demand Elasticity	Estimated 2004 Beef Offal Price Without Export Market Losses ($/lb)	Estimated Beef Offal Price Difference Attributable to Export Market Loss ($/lb)	Estimated U.S. Beef Industry Loss
-2.00	-0.57	$0.90	$0.33	$343,632,987
-1.00	-0.57	$1.00	$0.43	$448,780,151
-2.00	-0.67	$0.89	$0.31	$331,244,054
-1.00	-0.67	$0.98	$0.40	$422,716,385
-2.00	-0.77	$0.88	$0.30	$319,717,347
-1.00	-0.77	$0.96	$0.38	$399,513,854

production categories were not affected by the ban on U.S. beef and by-products so they were excluded from the analysis. Estimated offal production was derived by obtaining tongue, cheek meat, heart, liver, and tripe production estimates per hundredweight of live animal processed from USDA, and aggregating them on a per head basis. Estimated offal production per head processed totaled 32.25 pounds.

Annual commercial cattle slaughter during 2003 totaled 35.494 million head, resulting in estimated U.S. offal production of 1.44 billion pounds. During 2004, estimated U.S. commercial cattle slaughter was 32.726 million head, yielding an offal production estimate of 1.055 billion pounds. Annual average prices for beef offal were estimated using offal product price data reported by USDA and summarized by LMIC. Prices were weighted by each product's relative contribution to offal production per head. Estimated annual average beef offal prices were $0.75 and $0.58 per pound, during 2003 and 2004, respectively. U.S. exports of beef offal during 2003 totaled 970.1 million pounds. January through August data were used to project offal exports for 2004, resulting in an estimate of 344.8 million pounds.

Deriving estimates of beef industry losses associated with the reduction in offal exports required demand elasticity estimates for both the U.S. and international markets. Little research has been conducted on beef offal demand, in either the domestic or international markets. Zhou estimated own-price import demand for beef variety meats and concluded that demand in some countries, including Mexico, South Korea, and Japan, was very inelastic. The same study also indicated that beef variety meat import demand in Canada is very elastic. However, these estimates were actually aggregate level elasticities as opposed to country level elasticities. This distinction is important because country level estimates are generally more elastic than aggregate elasticities. The reason is straightforward. There are many substitutes for beef or offal imported from a single country, which leads to more elastic own-price elasticity estimates. In this case, there are many potential substitutes for U.S. offal from other exporting countries, such as Australia. As a result, we used two elasticity estimates, -2.0 and -1.0, for the rest of the world market. For the domestic market, given the lack of published estimates, we used the same elasticity estimates as used in the carcass beef analyses, i.e., -0.57, -0.67, -0.77.

Estimates of losses resulting from beef offal export losses are reported in Table 3.6. Results indicate that U.S. offal values would have been $0.30 to $0.43 per pound higher during 2004 had export markets remained open. Loss estimates for 2004 range from a low of $320 million to a high of $449 million. The more inelastic (smaller in absolute magnitude) elasticity estimates yield the largest loss estimates and the more elastic (large in absolute magnitude) elasticity estimates yield the smallest loss estimates.

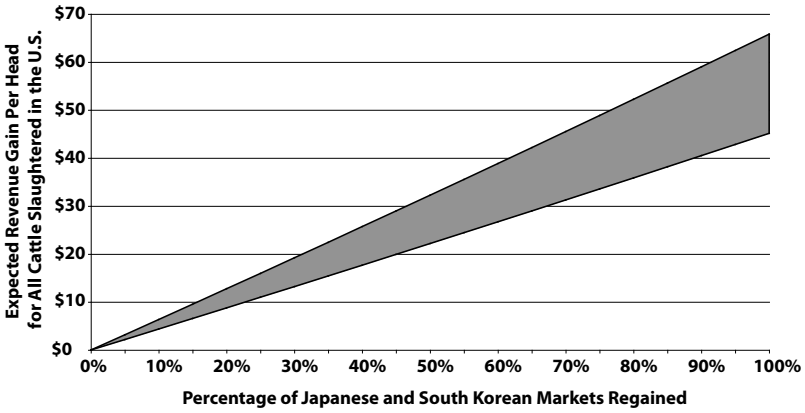
3.9 Potential Revenue Gains from Reopening Japanese and South Korean Markets

Japan and South Korea, the largest and third largest, respectively, importers of U.S. beef during 2003 have yet to reopen their markets to U.S. beef. The inability to export to these two key markets has obviously hurt the U.S. beef industry. In fact, much of the discus-

sion regarding U.S. beef exports during 2004 and 2005 focused on regaining access to these markets. Their continued closure raises the question: What benefits would have accrued to the U.S. beef industry if market access to these two key markets had been regained during 2004?

The impact of an increase in beef exports to Japan and South Korea can be estimated using the same methodology presented in sections 3.7 and 3.8 and detailed in Figure 3.7. Effectively, beef exported to Japan and South Korea results in a smaller domestic supply being made available to U.S. consumers, which raises the average price received for all beef sold in the United States. To estimate that impact, several assumptions were made. First, it was assumed that exports to Japan and South Korea, as a percentage of U.S. beef production, would not exceed the level attained during 2003. Since U.S. beef production declined 6.4 percent from 2003 to 2004, this means that, even with unrestricted access to these two markets, beef and offal exports to Japan and South Korea during 2004 would have been smaller than in 2003. Holding Japan and South Korea's imports at this level implies that the United States would have exported a total of 1.02 billion pounds of beef and 242 million pounds of beef offal during 2004 to these two countries. Second, to estimate the gain arising from open access to Japan and South Korea's export markets, the small quantities of beef and offal exported to these two countries during 2004 was subtracted from these totals. Based on FAS data we estimate that total beef exports from the United States to Japan and South Korea during 2004 totaled approximately 766,000 pounds of beef and about 2.6 million pounds of beef offal. Thus, in our analysis, open access to the Japanese and South Korea export markets would have boosted U.S. beef exports by about 1.019 billion pounds and beef offal exports by approximately 239.4 million pounds. Applying these quantities to the analytical technique outlined in sections 3.7 and 3.8 reveals the total revenue gain that would have accrued to the U.S. beef industry from unrestricted access to the Japanese and South Korean export markets. Sensitivity analysis, conducted in increments of 5 percent, was performed to provide information regarding the expected impact on industry revenues if only a portion of the 2003 market share was regained during 2004. Finally, to make the results easier to interpret, the revenue gain was divided by the number of cattle slaughtered (32.7 million) in the United States during 2004 to provide an estimate of the expected wholesale revenue gain per head.

Figure 3.8 *Estimated Wholesale Revenue Gain per Head from the United States Regaining Access to Japanese and South Korean Beef Markets.*



Results are in reported in Figure 3.8. The figure reports the minimum and maximum expected revenue gain, per head, from the increase in exports, depending on the domestic and world own price elasticities of demand. If the United States did not regain access to the Japanese and South Korean markets, no increase in revenue would occur, relative to what took place during 2004. Conversely, if U.S. beef exports to both markets resumed and exports to Japan and South Korea as a percentage of U.S. production reached their 2003 level, the estimated wholesale revenue gain would have ranged from about $45 to $66 per head, for every head slaughtered in the United States. If the United States only regained some of its former exports to these two important markets, the wholesale revenue gains would have been smaller. For example, if exports to Japan and South Korea during 2004 equaled one-half of their 2003 share of U.S. production, the estimated wholesale revenue gain per head likely would have ranged from about $22 to as much as $32 per head.

Changes in the Beef Packing Sector

Concerns about BSE and related food safety implications have caused major changes in cattle procurement, slaughtering, processing, fabrication, and rendering in the United States. These changes have evolved over the past several years and have been driven by both regulatory policy and customer preferences. Since BSE appeared in the United States, changes have occurred more rapidly and have been more pronounced. In particular, FSIS Interim Final Rules regarding new definitions and procedures for specified risk materials (SRMs) and processing requirements, as well as amendments (or proposed amendments) to the FDA ban on the use of certain beef products in animal feed and human cosmetics have altered the physical processes, equipment needs, and market alternatives for beef packers and processors. The economic impacts of these changes vary from firm-to-firm, and even from plant-to-plant within the same firm. Furthermore, a dynamic and complex market environment makes obtaining precise data on these impacts difficult. However, understanding these impacts, at least qualitatively, is important when evaluating current policies or considering policy alternatives.

To gain a conceptual understanding of which areas of the meat packing business have been affected by recent BSE policy and market changes, we relied on previous regulatory mandates to the packing sector (e.g, HACCP rules) and on expert opinion. This research made it evident that the economic effects could be examined in several broad categories. These categories and their respective sections are as follows:

4.1. Changes in Procurement
4.2. Changes in Employment
4.3. Employee Training
4.4. HACCP (Hazard Analysis of Critical Control Points), SSOPs (Sanitation Standard Operating Procedures), and Record Keeping
4.5. Facility Modification Investment
4.6. Lost Products

Although details under each category vary across the industry, these broad areas provide a useful framework for evaluating economic impacts on a firm-level basis. It is important to keep in mind throughout this discussion that costs associated with new rules are passed back to producers in the form of lower fed cattle prices and to consumers through higher beef prices. However, we do not attempt to estimate how much of these costs were passed along in these ways.

To gather data for this segment of the study, we elicited the assistance of several meat packing firms. We presented the purpose and scope of our study and requested that firms engage in a dialogue with us, either in person or by phone, about how the BSE case in Washington state and subsequent regulations have impacted their respective firms. Of the firms approached to participate, we secured on-site interviews with four slaughter and processing firms (with follow-up via phone and e-mail communication) and we conducted phone interviews with three additional firms (one firm contacted declined to participate). Interviews were conducted between late September and early December, 2004. Of the seven participating firms, one firm provided limited information with the other six giving full cooperation. One firm was only asked to contribute information regarding how procurement practices have changed.

The seven participating firms included four relatively large beef packers with several plants and three smaller firms. Collectively, these seven firms represent more than 60 percent of U.S. cattle slaughter in 2003. The firms interviewed represented both fed and non-fed (both dairy and beef) slaughter activities as well as the spectrum of cattle procurement methods (live auction, direct negotiation, dressed purchase, etc.). Among the firms, several branded and specialty products are produced. Although these specific firms do not include the entire beef packing and rendering sector, virtually all types of firms, procurement methods, and marketing activities present in the sector are represented in the sample. The data gathered from these interviews, along with certain other industry data comprised the basis for the following analysis of cost, revenue, and procedural changes in the

packing sector. Where appropriate, we have aggregated cost estimates to the industry level. In doing so we assume 32.7 million head of total slaughter with 80 percent of slaughter being fed and 20 percent non-fed. Tables 4.1 through 4.4 summarize the estimates presented in this discussion.

4.1 Changes in Procurement

A major distinction packers must make under the new Interim Final Rules is between cattle that are under 30 months of age (UTM) and those 30 months of age and older (OTM). Many specified risk material (SRM) definitions depend on the 30-month age division. In particular, OTM animals have more condemned material that cannot come into contact with products destined for the human food supply. As a result, OTM and UTM cattle must be segregated, which increases costs when both types of animals are present.

All fed cattle slaughter firms we interviewed accept OTM cattle for slaughter. However, all those involved in predominantly fed slaughter indicated that it was not desirable to purchase these animals because of the increased costs they bring to the firm. When cattle are procured on a live basis, packers absorb the risk associated with the age of animals. Packers rely on relationships with feeders and the ability of buyers to recognize OTM cattle to ensure that only a minimal level of OTM cattle are presented for slaughter. Among firms primarily focusing on fed slaughter, the frequency of OTM cattle is generally "very low" but can be as high as 2 percent to 3 percent (varying by plant location and by season). Packer willingness to purchase cattle that may be OTM at this time is certainly related to the current tight cattle supply situation. Packers cannot afford to be as selective about cattle procurement as they likely would be given more ample supplies relative to slaughter capacity. Therefore, if more slaughter cattle become available, it may become more difficult to find a viable market for OTM fed cattle.

Many fed cattle slaughter firms that purchase cattle on a carcass basis are discounting animals that a dentition test identifies as OTM. The *USDA Weekly Slaughter Premiums and Discounts* report has, with little variation, reported the range of these discounts to be between $0 and $35 per hundredweight carcass weight basis since it began reporting the discount in January 2004. Participating firms in this study indicated that discounts they assign are generally between $0 and $10 per hundredweight, with one firm discounting on a percentage basis at 20 percent of the value of the carcass. A few packers are able to use source verification agreements to identify groups of cattle in which there are no OTM animals. These agreements represent a small overall proportion of cattle slaughter, but they have become more valuable and will likely become more popular in the current environment.

4.2 Changes in Employment

Across the packing sector, BSE regulations and market situations have created and eliminated jobs. Overall, there has been a pronounced net loss in jobs. The creation of positions has been due to the need to identify the age of all animals (the alternative is to treat all animals as if they are OTM) and the need to segregate SRMs. The elimination of jobs has primarily come from the closure of export markets and the condemnation of the small intestine from the human food supply. There was not an immediate realization of this decrease in jobs because most packers did not lay off employees right away. Rather, they reassigned labor and then as attrition occurred refrained from replacing employees.

To comply with new Interim Final Rules, the packers we interviewed have added an average[6] of approximately two jobs per 1,000 head of daily slaughter capacity. Firms that deal with non-fed slaughter and smaller firms added more jobs (on a per head basis). These new jobs are primarily labor-level positions. Some flexibility exists in the methods of complying with FSIS regulations and, therefore, there is variation in the types of jobs added across firms and plants. However, some labor impacts are similar across firms. Many firms have added a position that focuses on management of non-ambulatory cattle. Duties include physically segregating such animals and ensuring proper procedures are followed in removing non-ambulatory and lame animals from the premises. For any firm dealing with fed slaughter, at least one position per plant per shift has been dedicated to performing post-mortem dentition[7] on cattle

[6] *All averages reported in the text of Section 4 are weighted based on daily slaughter capacity.*

[7] *FSIS has determined that, absent reliable production records, dentition is the "best and most practical method of age determination" for cattle. The teeth and gums are examined for the presence of at least one of the set of second permanent incisors. If such is present the animal is deemed OTM. Past research has shown that the second set of permanent incisors can erupt through the gumline at anytime between 24 and 30 months.*

Table 4.1. *Summary of Per-Head Costs to the Beef Packing Sector Associated with Compliance with U.S. BSE Regulations.*			
Area	**Description**	**Range**	**Weighted Average[1]**
Increased Employment	Jobs created to comply with FSIS Interim Final rules	$0.26 to $0.77 (per head)[2]	$0.45 (per head) [2]
Decreased Employment[3]	Jobs eliminated in response to FSIS Interim Final rules	$0.83 to $5.27 (per head)[2]	$1.02 (per head)[2]
HACCP, SSOP, Verification	Ongoing monitoring and recordkeeping	$0.01 to $0.09 (per head)[2]	$0.01 (per head)[2]

[1.] *Weights were determined by daily slaughter capacities.*
[2.] *Cost per head of daily slaughter capacity.*
[3.] *Estimate assuming 90% of all positions lost were lost due to regulatory changes. See text for discussion.*

Table 4.2. *Summary of Firm-Level Costs to the Beef Packing Sector Associated with Compliance with U.S. BSE Regulations.*			
Area	**Description**	**Range**	**Weighted Average[1]**
Training Existing Employees	One-time, firm-level training expenses related to FSIS Interim Final Rules	$13,800 to $100,000 (per firm)	$41,317 (per firm)
HACCP, SSOP, Verification	Initial firm-level review/development of HACCP, SSOP, and Verification Pans	$0 to $6,360 (per firm)	$5,018 (per firm)
New Investment	New equipment purchased at the firm level	$0 to $84,000 (per firm)	$63,758 (per firm)
Lost Investment	Lost Value of equipment at the firm level	$28,500 to $1,000,000 (per firm)	$773,709 (per firm)

[1.] *Weights were determined by daily slaughter capacities.*

Table 4.3. *Summary of Costs to the Beef Packing Sector Associated with Products Removed from the Food Supply by U.S. BSE Regulations.*			
Area	**Description**	**Range**	**Simple Average**
Lost Products			
	Brains in OTM Cattle	$0	$0
	Small Intestines from All Cattle	$3.23 to 4.13 (per head)[1]	$3.68 (per head)[1]
	Bone-in Cuts from OTM Cattle	$7 to $10 (per head)[2]	$8.50 (per head)[2]
	Reduced AMR Product (UTM)	$0.15 to $0.60 (per head)[3]	$0.38 (per head)[3]
	Reduced AMR Product (OTM)	$3.27 to $15.44 (per head)[3]	$9.35 (per head)[3]
	Non-ambulatory Cattle	$63,232,000 (industrywide loss)	$63,232,000 (industrywide loss)

[1.] *Only considers cattle from which the small intestine was sold.*
[2.] *Only considers cattle that are over 30 months old.*
[3.] *Only considers cattle that are over 30 months old slaughtered in plants using AMR system*

to determine whether they are OTM. Other added positions include personnel to segregate vertebral bones so they are not sent through advanced meat recovery (AMR) systems and to monitor removal of spinal cord material.

In total, the jobs created to comply with the Interim Final Rules added an average production cost of approximately $0.45 per head, based on daily slaughter capacity. This indicates that the beef packing sector spent about $14.7 million in 2004 on wages for additional jobs to comply with BSE regulations. The range of this cost was $0.26 to $0.77 per head, across firms. Firms with non-fed slaughter tended to face greater cost increases. The wide variation is partly because some firms were better able to add tasks to duties of existing employees, as opposed to creating new positions. There are costs associated with reallocating employee time since the employee is asked to take on more responsibility and

Table 4.4. *Summary of Selected Costs to the Beef Packing Sector for the Year 2004 Associated with BSE Regulations*[1].			
Area	**Low**	**High**	**Weighted Average**[2]
Increased Employment	N/A	N/A	$14,715,000
Decreased Employment	N/A	N/A	($33,354,000)
HACCP, SSOP, Verification (ongoing)	N/A	N/A	$327,000
Lost Products			
Brains, Eyes, etc. in OTM Cattle	$0	$0	$0
Small Intestines from All Cattle	$84,366,000[3]	$107,910,000[3]	$96,138,000[3]
Bone-in Cuts from OTM Cattle	$22,890,000	$32,700,000	$27,795,000
Reduced AMR Product (UTM)	$2,197,440[4]	$8,789,760[4]	$5,493,600[4]
Reduced AMR Product (OTM)	$8,542,875[4]	$40,384,500[4]	$24,463,688[4]
Non-ambulatory Cattle[5]			
Fed	$2,485,200	$2,485,200	$2,485,200
Non-fed	$62,130,000	$62,130,000	$62,130,000
Total	$64,615,200	$64,615,200	$64,615,200
Net Industry Impact[6]	$164,299,515	$110,192,460	$20 0,193,488

1. *Assumes 32.7 million head of total slaughter for 2004.*
2. *Weights were determined by daily slaughter capacities. In the cases of lost products and non-ambulatory cattle, all observations were given equal weight.*
3. *Assumes that small intestines were only sold from fed slaughter animals.*
4. *Assumes that 56 percent of UTM and 40 percent of OTM cattle are processed using AMR systems.*
5. *Assumes 32.7 million head of total slaughter with 80% fed and 20% non-fed and that 0.01 percent and 2 percent of fed and non-fed slaughter is non-ambulatory, respectively.*
6. *Ignores one-time expenses for which a reliable industry-level average was not available. Firm-level estimates for these costs are reported in Table 4.2.*

production and/or quality of performance is likely affected. However, we did not attempt to quantify such costs.

Firms tended to eliminate at least twice as many jobs as they created. However, a multitude of factors simultaneously influenced the number of jobs eliminated. These include removal of existing products from the food supply, changing nature of international markets, varying production levels, tightening cattle supplies, and individual firms' focus on international trade. These factors affect firms and plants very differently, resulting in a range of decreased labor costs of $0.92 to $5.85 per head of daily capacity. The average decrease in production costs of all reporting firms was $1.14 per head based on daily slaughter capacity. Firms with lines dedicated to processing by-products and niche products for export saw the largest decline in jobs.

Only a portion of the total jobs eliminated were eliminated strictly because of new regulations. Because the changes in employment were caused by so many factors that occurred simultaneously, it is difficult to isolate how many position changes were attributable to regulatory changes. Based on discussions with firms, we estimate the portion of positions lost as a result of regulatory change to be almost entirely associated with small intestine processing and to be approximately 90 percent of the total jobs lost. This would imply a reduction in labor costs of about $1.02 per head of daily capacity, or an average decrease of $33.4 million in annual labor costs in 2004, strictly due to regulatory changes. The loss of a job due to regulatory changes was accompanied by the loss of a certain product so that any cost savings from employment decreases are offset by foregone revenue from the condemned

products. These revenue losses are estimated in Section 4.6.

The loss of income from the eliminated jobs and the cost of that loss to the U.S. economy and the economies of communities relying on packing plants for employment is another major component of the cost of the U.S. BSE incident. This cost, however, is not directly realized by the beef sector and is, therefore, outside the scope of this study, but it is worthy of future research.

4.3 Employee Training

Beef packing and processing firms have found it necessary to specifically train employees in several areas to ensure compliance with FSIS Interim Final Rules. For many firms, this has included training employees to perform dentition. The exception to this requirement occurs when a plant slaughters only OTM animals or chooses to treat all animals as if they are OTM. Further training includes how to properly mark OTM carcasses, how to use different equipment (knives, saws, etc.) on UTM and OTM cattle, how to clean equipment between OTM and UTM carcasses, and how to properly segregate SRMs.

Firms have used various strategies to accomplish the necessary training. Typically, the plan for training is developed at the corporate level, followed by management level training. Finally, individual labor-level training takes place in the plants. Firms consistently allocate 1 to 2 hours of initial training to plant employees. This often includes on-the-job training. Firms vary, however, in the number of employees trained. Some train only those directly affected by the rules (e.g., dentition personnel), while others train all plant employees. We encountered firm-level estimates of one-time training costs ranging from $13,800 to $100,000. The average initial investment in training existing employees was $41,317. One firm was using a formal ongoing training program to review and evaluate employee performance. However, in most cases, ongoing training expenses were not reported.

The partial re-opening of trade to Mexico and Canada for establishments completing beef export verification (BEV) through the USDA Agricultural Marketing Service (AMS) also involves employee training. The developing Japan BEV program will likely have similar effects if it comes to fruition. Training costs associated with BEV programs are highly variable across firms, but, thus far, have been nominal.

4.4 HACCP, SSOPs, and Record Keeping

FSIS Interim Final Rules require that certain procedures for compliance be documented in HACCP and Sanitation SOPs. Many of the rules also require record keeping and ongoing verification to ensure that employees are continuing to use suitable practices. Implementing, enforcing, and monitoring these changes comes at a cost for meat packing firms. The first cost incurred was the initial review and revision of all written HACCP and SSOP plans. This was typically a corporate level endeavor with changes passed on to plants. The initial costs related specifically to HACCP and SSOP plans were nominal. The average initial cost observed was about $5,000 with some firms spending far less than that. The more relevant cost is the day-to-day cost of monitoring and documenting procedures, which we estimated to average $0.01 per head based on daily capacity. This suggests that the industry spent an additional $327,000 in 2004 in ongoing HACCP, SSOP and record keeping requirements. There appear to be economies of size associated with this cost, as one of the smallest firms interviewed reported a per head cost of $0.09 per head. HACCP, SSOP, and record keeping costs are separate from the employment costs reported above. Seldom did these monitoring and verification duties necessitate hiring new employees, but rather caused a reallocation of food safety and/or quality assurance personnel.

4.5 Facility Modification Investment

BSE regulatory changes have influenced capital investments made by meat packers. Certain regulations required firms to purchase new equipment. Many firms had to at least improve, if not add, facilities for dealing with non-ambulatory animals. Some equipment has been purchased for dentition. FSIS requires firms with any portion of fed slaughter that wish to salvage offal and by-products from UTM animals may either thoroughly wash equipment such as split saws or knives

(used in the final stage of removing the head) between OTM and UTM carcasses or have separate equipment dedicated to each. Firms choosing the latter had to purchase new saws and knives. Another common investment has been in steam vacuum equipment. Steam vacuums are used to treat the head after an animal has been stunned to ensure that brain matter does not come in contact with other products. In some cases, firms purchased an extra steam vacuum system as a backup to ensure production can continue should the primary system break down. Given flexibility in the means of compliance with FSIS rules, some firms were able to comply without any new investments. In our sample, the average investment in new equipment was $63,758, with a high of $84,000. Most of this investment is long-term in nature.

The value of some existing investments also was influenced by the regulatory changes. Equipment formerly used to process small intestine is now sitting idle. AMR equipment that cannot meet new requirements concerning maximum allowable levels of iron or calcium is also obsolete. This equipment could potentially be sold to plants in other countries where small intestines are still processed or AMR restrictions differ. However, we have not observed such sales, nor do they appear practical. Therefore, we treat these obsolete machines as having no value. Some AMR systems, primarily in non-fed slaughter plants, now run at a very low capacity due to the ban of OTM vertebral columns and skulls in AMR processing and, as a result, are less valuable. Among the firms surveyed, the highest value of lost investment was $1,000,000 with the lowest being $28,500. The average lost investment across firms was $773,709.

Firms also have encountered customer preferences requiring that ground products be free of AMR. In some cases, firms do not market any ground beef containing AMR product under their label. Rather, AMR product is sold for further processing to other firms. Another, less common, response has been to abandon use of AMR systems entirely. However, some of these changes had been taking place years prior to the U.S. BSE incident. Since these changes are market driven and have been occurring for quite some time, there is no reason to associate them specifically with recent regulations and we did not attempt to quantify their impacts for this study. However, this provides another example of how BSE and related food safety concerns are, and have been, changing the meat processing environment.

4.6 Lost Products

FSIS Interim Final Rules removed specific products from the food supply that were previously being sold by several meat packers and processors domestically and/or internationally. Products that were commonly sold and are now condemned, include brains from OTM cattle, small intestines of all cattle, and bone-in cuts from OTM cattle containing vertebral column (T-bone steaks are in this category). Product obtained by AMR systems from skulls and vertebral columns of OTM animals is condemned as well as all non-ambulatory cattle. The revenues from these products (with the exception of the bone-in cuts from OTM animals) have been eliminated by the BSE regulations. The only alternative market for these materials is inedible rendering. Product going to inedible rendering is typically sold for $0.04 to $0.05 per pound.

Brains and Eyes of OTM Cattle

The removal of OTM cattle brains from the market seems to have had little, if any impact. Firms interviewed indicated that the market for brains, as a specific product, was quite small and that brains were almost all exported. Few of the plants owned by the firms we surveyed were selling brains prior to the U.S. BSE incident. Because only about 20 percent of slaughter comes from OTM cattle (FSIS), UTM cattle can provide enough brains to supply the market, even if all export markets open again. The same is thought to be true of the market for eyes and spinal cord sold as edible material. Therefore, we assume that the condemnation of OTM brains, eyes, and spinal cord has not resulted in significant revenue losses for the beef sector.

Vertebral Column of OTM Cattle

The Interim Final Rule prohibiting bone-in cuts from OTM cattle containing vertebral column has had a pronounced impact on non-fed slaughter revenue since the rule removes

the T-bone cut from the food supply. T-bones from OTM cattle have been heavily utilized by family-style and discount restaurants to provide a low-cost steak product. Processors of non-fed cattle were able to readily market T-bones to such restaurants. Presently the bone must be removed from these cuts and they are now sold as strips or short loins, neither of which is as desirable to consumers as the T-bone cut. Non-fed processors have expended substantial research effort to develop a method of leaving some bone in the T-bone while removing the vertebral column. This effort has not resulted in a cut that complies with the Interim Final Rule and is accepted by consumers as being nearly equivalent to the traditional T-bone. One non-fed slaughter firm estimated that the lost value in OTM cattle due to the loss of T-bones ranged from $7 to $10 per head. Non-fed (or OTM) slaughter comprises 20 percent of U.S. slaughter (FSIS). However, industry opinion suggests that only half of OTM cattle will yield a marketable bone-in product.[8] Using these estimates, we calculate a total loss in the value of the bone-in OTM product of $27.8 million in 2004 at the industry level.

Small Intestine of All Cattle

The small intestine from all cattle has been banned from the food supply by the FSIS Interim Final Rules. FSIS determined the distal ileum to be an SRM, but went further in the Interim Final Rule and stated that, to ensure complete removal of the distal ileum, the entire small intestine would be disposed of as inedible. Based on industry information, the per head yield of the entire raw small intestine is estimated to be 13 to 17.5 pounds, with about 4 pounds of that being the distal ileum. The 9 to 13.5 pounds per head of small intestine that is currently condemned from the food supply is a hotly debated topic. Firms from the United States and abroad, as well as industry and trade groups, have offered public comments to FSIS recommending that meat processors be allowed to sell the small intestine, minus the distal ileum, as an edible product.

Prior to the 2004 BSE regulations, most of this small intestine was processed to varying degrees and sold as trepas (or tripas)[9] to Mexico and as an edible product to Japan and Korea. The processing includes washing and cooking and can include further activity such as scalding, bleaching, and splitting. Further-processed small intestines were targeted primarily at the Japanese market and would receive a premium, on a per pound basis, over the less processed product. This variation in value-added processing and end markets results in a wide range of yields and prices reported by processors prior to the BSE incident. We have encountered reports of small intestine sale weights ranging from 3.17 pounds to more than 7 pounds, with prices ranging from $0.43 per pound up to $3.00 per pound. Based on discussions with several industry participants, we believe that the highest reported prices were likely for a limited amount of product, highly-processed to meet certain specifications of a particular customer and were not representative of industrywide commodity prices. It is not clear how many meat processors had the ability to realize prices as high as $3 per pound or how often they could do so. However, these high-end prices demonstrate that the effect of banning the small intestine differs markedly across the industry.

Based on other reported prices and 2003 USDA-reported average prices for trepas, which would have included both exported product and product sold domestically, we estimate that prior to the U.S. BSE incident, a representative price range per pound for small intestines was $0.43 to $0.55, with an average per head yield of 7.5 pounds of processed, sellable product. If export markets were reopened, this indicates forgone revenue of $3.23 to $4.13 per head for processors who previously sold small intestine.

Not all beef packers were processing and selling small intestines as an edible product prior to the FSIS Interim Final Rules, and it is not clear, on an industrywide basis, what proportions of packers were doing so. This is primarily because of customer demands and quality issues. For example, small intestines from OTM animals were not as desirable. Given this information, we assume that small intestines were sold only from fed slaughter animals (80 percent of U.S. slaughter). Under this assumption, removal of the small intestine from the food supply cost the industry approximately $96.1 million in 2004.

[8] *A large portion of slaughter cows (and bulls) are of a quality (e.g., those graded as dark cutters or canners) that precludes their yielding any bone-in product that would be desirable to customers.*

[9] *A small amount of beef small intestine was also sold as casings for high-quality, natural sausages. However, the majority of beef intestines used in U.S. sausage casings was imported from South American countries. Therefore, we only use the price of trepas to estimate loss to the beef industry due to condemnation of the small intestine from the food supply.*

Advanced Meat Recovery (AMR)

The portion of the FSIS Interim Final Rules mandating more stringent controls over AMR use influenced the amount of beef product available for sale. Specifically, the rules limited the materials from OTM cattle that could be processed using AMR systems and set stricter levels of testing for calcium and iron. This was a measure aimed at keeping bone material and, potentially, higher-risk non-meat material out of food. AMR product also must be tested to ensure it is free of spinal cord and dorsal root ganglia (DRG). If it is not, it cannot be sold as "meat." In the fed cattle sector (UTM), the efficiency of AMR systems decreased as firms had to test product regularly and, should results be unacceptable, shut down until compliance was achieved. Diversion of noncompliant batches of AMR product to rendering, and subsequent stoppages of AMR systems for recalibration, has decreased yields by about 20 percent. AMR yield from fed cattle slaughter is about 3 pounds per head (FSIS). Therefore, a loss of AMR product equivalent to 0.6 pounds per head was realized for fed slaughter cattle process using AMR systems. We assume this efficiency loss was the only regulatory impact on AMR activities in the fed sector, since no other restrictions were imposed for UTM material.

Firms using AMR technology to process OTM have realized a substantial decline in product yields as they are now unable to process OTM vertebral columns. This yield reduction (including the efficiency losses mentioned above) is estimated to be been between 1.1 percent and 1.3 percent of body weight. Industry estimates suggest average non-fed slaughter weights of 1,150 pounds for beef cows and 1,225 pounds for dairy cows. Using the average non-fed slaughter weight of 1,188 pounds, we calculate a loss of 13.06 to 15.44 pounds of AMR product for non-fed slaughter cattle.

AMR product is used as an addition to inexpensive ground product and, in some cases, in processed meat items (e.g., beef sticks, pepperoni). If included in ground beef, the value of this product is about $1.00 per pound. If AMR is sold as a product to processors, the value is in the neighborhood of $0.25 per pound. Therefore, due to decreases in efficiency, packers processing UTM cattle using AMR systems are losing $0.15 to $0.60 per head in potential revenue. Processors of OTM cattle face an average revenue decrease ranging from $3.27 to $15.44 per head attributable to the changes regarding use of AMR systems. FSIS estimates that 40 percent of all non-fed slaughter cattle (or 8 percent of all beef slaughter) and 56 percent of fed slaughter (or 45 percent of all slaughter) are processed using AMR systems. These proportions, along with yield losses described above, indicate that the Interim Final Rules applying to AMR resulted in the loss of approximately $30 million ($24.5 million from OTM cattle and $5.5 million from UTM cattle) worth of product in 2004.

Non-ambulatory Cattle

The condemnation of non-ambulatory cattle from the food supply represents a loss of marketable product for beef packers. We encountered a variety of methods for dealing with non-ambulatory cattle prior to the U.S. BSE incident. Many firms prohibited the slaughter and processing of non-ambulatory animals. However, some firms felt they could distinguish between animals that were non-ambulatory due to suspect reasons (i.e., central nervous system symptoms) and those that were physically injured and would present only injured cattle for slaughter, contingent upon FSIS inspection approval. Few firms interviewed allowed non-ambulatory animals to be slaughtered and processed completely along with the rest of their kill. This was often due to a desire to comply with the federal school lunch program or in response to specific consumer concerns. One common alternative was to slaughter the animal and sell the whole carcass either to employees or to a processor at a discount price. Because of these considerations, very few of the non-ambulatory animals slaughtered brought in as much revenue as healthy cattle. Nonetheless, the removal of these animals from the food supply does represent a loss of revenue.

The number of non-ambulatory cattle is seasonal and also varies spatially, making a nationwide average difficult to estimate. However, information gathered from surveyed firms serves as a basis for establishing a rea-

sonable estimate. Based on interviews with slaughter firms, a very small portion of cattle presented for slaughter are non-ambulatory. Furthermore, nearly all firms surveyed agreed that there has not been a noticeable change in the number of non-ambulatory cattle received relative to previous years. Production records for this year show only about 0.01 percent of fed cattle presented for slaughter are non-ambulatory, among the firms surveyed. The percentage of non-fed slaughter in the same category is, on average, around 2 percent. Continuing to work under the assumption that 20 percent of total beef slaughter is non-fed, this translates into a condemnation of 0.4 percent of total beef slaughter. This number is consistent with the FSIS estimate of the portion of slaughter that is considered non-ambulatory (FSIS). In 2004, we estimate that approximately 133,416 non-ambulatory cattle were presented for slaughter and condemned from the food supply. This estimate ignores animals that were down or dead on the farm. However, few of the animals dead or down on the farm would have actually gone to slaughter before the change in FSIS regulations and would have, instead, gone to rendering.

The general opinion of the firms interviewed was that practically all of the non-ambulatory animals condemned this year could have been slaughtered and sold, in some fashion, under previous regulations. We assume the market value for a fed slaughter animal is $1,000 per head (as quoted by a slaughter firm interviewed) and that the average market value for a non-fed animal is $500. These values might be slightly high due to reasons noted above. However, a reliable market estimate does not exist. This would indicate that, for 2004, removing non-ambulatory cattle from the food supply resulted in a loss of approximately $64.6 million to the packing sector.

Lingual Tonsil

There has been some debate and, it appears, some confusion concerning the condemnation of the back portion of the tongue, the lingual tonsil. Some firms are presently removing this portion of the tongue, either because of specific USDA inspector requirements or a desire to be in compliance with a rule they assume will be mandated in the near future. Beef tongue has, historically, been a valuable export product. To remove a portion of it from the food supply is a contentious issue and there is much discussion about this among the industry. However, at this point, there is no formal federal regulation mandating removal of the lingual tonsil. Therefore, we do not treat it as a product lost due to U.S. BSE regulations.

Analysis of Feed-Ban and Specified Risk Material Policy Options

In August 1997, the U.S. Food and Drug Administration (FDA) banned the feeding of most ruminant derived proteins to ruminants.[10] The 1997 ban included exemptions for blood meal, plate waste, and poultry litter. Concurrently, the Canadian Food Inspection Agency implemented a similar measure, but without exemptions for plate waste and poultry litter. In November 2002, FDA sought comments on five aspects of the BSE feed regulations including the exemptions for plate waste and poultry litter, and the elimination of brain and spinal cord from rendered animal products.[11]

In response to the December 2003 discovery of BSE in the state of Washington, USDA, on January 12, 2004 banned from human food any material from downer animals, any specified risk material (SRM) including the small intestine, and mechanically separated beef.[12] In other rules published at the same time, USDA banned the use of air injection stunning devices and placed new restrictions on advanced meat recovery systems. On January 26, 2004, FDA announced plans to publish two interim rules. The first interim final rule, published July 14, 2004, banned from the FDA-regulated human food and cosmetics any material from downer animals, any materials designated as SRM, and mechanically separated beef.[13] This rule essentially extended the controls on SRM initiated by USDA in January 2004. The January 26 announcement also stated that a second interim final rule would eliminate the feed-ban exemptions for bovine blood products and plate waste, ban poultry litter from ruminant feed, and require the use of dedicated facilities for the processing of ruminant or non-ruminant feed.

On February 2, 2004 a panel of international experts (the International Review Team or IRT) commissioned by USDA to provide guidance on the response to BSE published a report containing recommendations for future actions. With regard to feed regulations, the IRT recommended that: a) unless aggressive surveillance showed BSE risk to be minimal, SRM should include the brains and spinal cords of all animals over 12 months and the entire intestine of all animals, b) that SRM should be excluded from all animal feed including pet food, and c) that all MBM, including avian, be excluded from ruminant feed. Subsequently, on July 14, 2004, the Food and Drug Administration published an Advance Notice of Proposed Rule making (ANPR) with an invitation to comment on several aspects of the ruminant feed ban, including the recommendations of the IRT.[14] The comment period for this notice ended on September 13, 2004. As of January 2005, no additional restrictions had been placed on ruminant feed and the exemptions for plate waste and bovine blood products in the 1997 feed ban remained in place.

If additional cases of BSE are found in the United States, it seems reasonable to assume that some of the measures proposed by FDA or recommended by the IRT would be implemented. The following analysis provides cost estimates for a selection of these measures. The analysis is confined to quantifying the potential cost to the cattle sector (in terms of dollars per head), and does not attempt to quantify impacts on other sectors or industries that would be impacted such as hogs or soybeans.

The Rendering Industry

The rendering industry processes about 47 billion pounds[15] of raw material annually, including inedible slaughter by-products, dead animals, and various other waste materials from different levels of the food chain. About 35 percent of that raw material comes from cattle slaughter, 15 percent from hog slaughter, and 40 percent from poultry slaughter. The two major products of rendering are high-protein animal feeds (e.g., meat and bone meal, blood meal, feather meal) and fats and greases (e.g., tallow). In 2000[16], total meat and bone meal (MBM) production from mammalian sources (cattle, hogs) was approximately 6.7 billion pounds, of which about 1.0 billion pounds were exported. Domestic consumption was dominated by the poultry industry (45 percent), followed by pet food (25 percent), hog feed (15 percent), and cattle

[10] *Federal Register: June 5, 1997 (Vol. 62, No. 108) "Substances Prohibited From Use in Animal Food or Feed; Animal Proteins Prohibited in Ruminant Feed; Final Rule."*

[11] *Federal Register: November 6, 2002 (Vol. 67, No. 215) "Substances Prohibited From Use in Animal Food or Feed; Animal Proteins Prohibited in Ruminant Feed; Advance notice of proposed rule making."*

[12] *Federal Register: January 12, 2004 (Vol. 69, No. 7) "Prohibition of the Use of Specified Risk Materials for Human Food and Requirements for the Disposition of Non-Ambulatory Disabled Cattle. Interim Final Rule."*

[13] *Federal Register: July 14, 2004 (Vol. 69, No. 134) "Use of Materials Derived From Cattle in Human Food and Cosmetics. Interim Final Rule."*

[14] *Federal Register: July 14, 2004 (Vol. 69, No. 134) "Federal Measures To Mitigate BSE Risks: Considerations for Further Action. Advance notice of proposed rule making."*

[15] *This estimate is taken from "The Rendering Industry: Economic Impact of Future Feeding Regulations." Report prepared for the National Rendering association, Sparks Companies Inc, June 2001*

[16] *Data for more recent years indicate similar levels of production, consumption, and exports. We use 2000 data here because more detailed breakdowns were available.*

Figure 5.1. *By-product Feeding Pathways.*

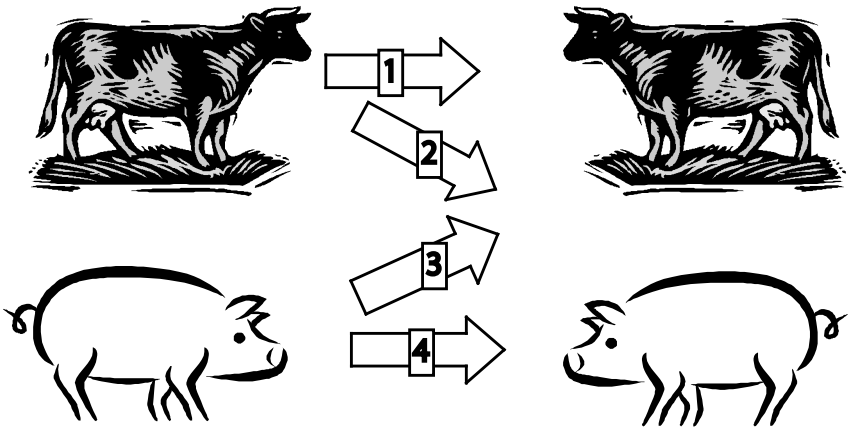
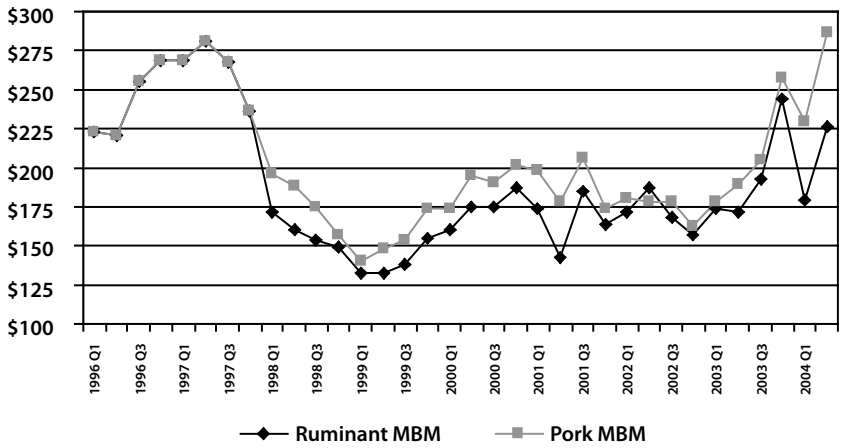


Figure 5.2. *Meat and Bone Meal (MBM) Prices.*



feed (10 percent). Thus while cattle slaughter accounts for more than 70 percent of mammalian MBM production, cattle feeding accounts for a much smaller share of MBM consumption.

5.1 Cost of the 1997 Feed Ban

In August 1997, the U.S. Food and Drug Administration banned the feeding of ruminant proteins, with the exception of ruminant blood meal and plasma, to ruminant animals (corresponding to a partial block of pathway #1 in Figure 5.1).[17] This required separation of proteins derived from ruminant and non-ruminant sources, and labeling of feeds containing ruminant derived protein with the instruction "Do not feed to cattle or other ruminants." In theory, this measure would be sufficient to prevent the spread of BSE. Experience in the United Kingdom, however, found that cross contamination and non-compliance undermined the effectiveness of a similar measure. For that reason, and given continued uncertainty about how BSE is transmitted, various means of enhancing the current feed ban are likely to be considered if additional BSE cases are found.

Prior to the feed ban, USDA reported a single price for MBM of ruminant or pork origin. However, given the new restriction and the separate identification of the two products, market conditions resulted in a discount for ruminant origin MBM relative to MBM from pork (Figure 5.2). While pork MBM continued to trade at a virtually unchanged premium relative to soybean meal (a substitute protein source), ruminant MBM, between January 1998 and December 2003, traded at an average discount of $15.78 per ton relative to porcine MBM. This discount provides an estimate of the cost of the regulation on the beef sector. The yield of MBM from cattle is approximately 8.5 percent of live weight,[18] and thus a 1,275 pound steer yields approximately 108 pounds of MBM. For that animal the cost of the regulation would be about $0.86. Similarly, for an 1,100 pound cow the cost would be about $0.74.

Following the BSE discovery the discount for ruminant MBM increased by more than $40 per ton, from $15.78 to an average of $58.56 during the first half of 2004. At that price differential, the cost of the regulation would be $3.17 for a steer and $2.74 for a cow.

5.2 Cost of the Proposed Restriction on Ruminant Blood Meal

In January 2004, FDA announced that the exemption for blood meal in the 1997 feed ban would be eliminated, but as of January 2005, it remained in place. Unlike MBM, where ruminants account for only 10 percent of consumption, blood meal is widely used in cattle feed, particularly for dairy cows and in milk replacement rations for calves. According to the 2001 Sparks report, ruminant feed accounts for up to 70 percent of blood meal consumption.

Figure 5.3 shows that until 2001, USDA reported a single price for blood meal of ruminant or porcine origin. During 2001-2003, porcine blood meal (PBM) traded at a slight premium (approximately 7 percent), perhaps reflecting a nutritional or palatability advantage. Following the January 2004 announce-

[17] *The measure is often referred to as a ban on protein derived from mammalian tissue in feed for ruminants, suggesting that it is much more restrictive than it actually is.*

[18] *The amount of rendered material from a cow or steer is approximately 34 percent of live weight. Of the material rendered, approximately half is water, and of the remainder about half is protein and half fat.*

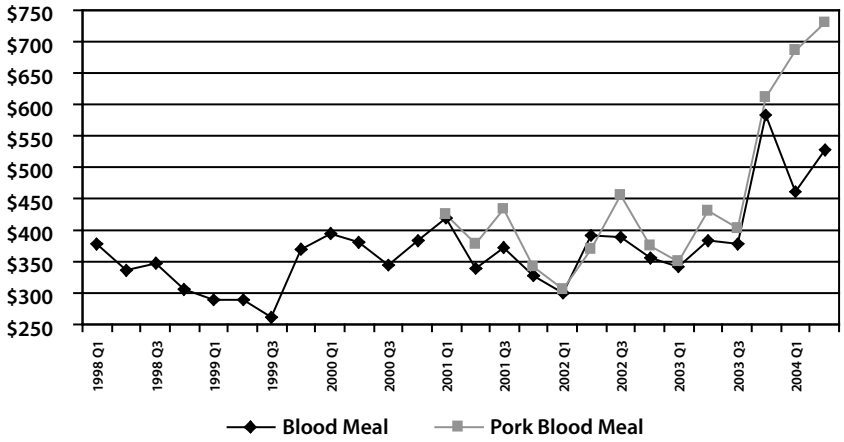
ment that the ruminant blood meal (RBM) exemption would be eliminated, the prices for RBM and PBM diverged. The price for PBM rose as users tried to lock in supplies while that of the soon-to-be-restricted RBM fell. In February, the average premium for PBM was about $520 per ton, but as the market readjusted that premium fell to just $78 per ton in the following 2 months. Overall, for the first half of 2004, the average premium for PBM over RBM was $250 per ton.

Part of the price differential between PBM and RBM represents a gain to the pork sector. Exactly how to divide the differential between a gain to PBM and a loss to RBM is not clear, but it seems reasonable to treat the $150 decline in the RBM price in the first quarter of 2004 as representing the loss to the beef sector (Figure 5.3).[19] The USDA By-Product Drop Value report indicates that the yield of blood meal from steers is 0.6 pounds per hundredweight of live animal and for cows is 0.73 pounds per hundredweight. A loss of $150 per ton in the value of RBM is equivalent to 7.5 cents per pound which translates into a loss of $0.57 for an average steer and $0.60 for a cow. Thus, while the exemption for RBM remained in place throughout 2004, the beef sector nevertheless suffered a loss as a result of its expected elimination.

If the blood meal exemption is eliminated, the price of RBM will decline further. The question is, how much? In an analysis for the National Renderers Association in 2001, Sparks Inc. assumed that if all types of blood meal and MBM were banned from ruminant feed, the market would be unable to absorb the excess supply of blood meal. The analysis proceeded on the assumption that the value of RBM would fall to zero and that more than 40 percent of production (100 million tons out of 226 million tons produced) would require disposal at a cost of $75 per ton. We consider that scenario unlikely, particularly for the less restrictive scenario considered here.

Because of its higher protein content, blood meal trades at a premium to MBM. If the exemption is eliminated and the price of RBM declines, manufacturers will find it profitable to substitute RBM for MBM or other protein sources in swine and poultry rations and pet food. In a worst case scenario,

Figure 5.3. *Blood Meal Prices.*



the premium for RBM over ruminant MBM, which averaged $225 per ton in 2003, would be eliminated.[20] Because blood meal represents less than ½ of 1 percent of the overall protein market, MBM prices themselves would not be expected to decline any appreciable amount. The elimination of a $225 per ton premium for RBM would represent an additional loss of $0.86 for an average steer and $0.90 for a cow.

5.3 Proposed Restrictions on SRM

Under current rules, specified risk material (SRM) is banned from human consumption. As currently defined in the United States, SRM includes:

> the brain, skull, eyes, trigeminal ganglia, dorsal root ganglia, spinal cord, vertebral column (excluding the vertebrae of the tail, the transverse processes of the thoracic and lumbar vertebrae, and the wings of the sacrum) from cattle 30 months of age and older; the tonsils and the distal ileum of all cattle.

Under that definition, animals over 30 months generate more SRM than younger animals. Informa Economics, in a 2004 report for the National Renderers Association, estimated that animals over 30 months generate 88.5 pounds of SRM and animals under 30 months 28.3 pounds. As noted above, the International Review Team recommended that SRM be excluded from all animal feed including pet food. The FDA has posted industry guidance that this measure is under consideration, but as of January 2005, it had not been implemented.

[19] *During the first quarter of 2004, PBM prices increased an average of $100 per ton and RBM prices decreased an average of $150 per ton compared to the previous quarter.*

[20] *Note that in February 2004, following the FDA announcement, the price of RBM fell but it continued to trade at a $150 per ton premium over MBM.*

In the United Kingdom, most SRM is disposed of via rendering and subsequent incineration or burial of the protein and tallow products (Priondata.org). If SRM is banned from animal feed, we assume a similar process would be used in the United States. We further assume that the yields of protein (i.e., MBM) and tallow from SRM are 25 percent each, thus the SRM from an animal under 30 months would yield approximately 7 pounds each of MBM and tallow. Banning animal consumption of SRM would eliminate the revenue from those products, which at current prices[21] would represent a loss of $1.63 for an animal less than 30 months of age, and $5.11 for an older animal.

Disposal of rendered products would involve additional costs. If the products are landfilled at a cost of $75 per ton, the cost per animal for disposal would be $0.53 for an animal less than 30 months of age, and $1.66 for an older animal.[22] Thus, total costs associated with the measure would, given current by-product values, be $2.16 per head for fed slaughter cattle and $6.77 per head for older animals.

Banning SRM also may create problems in the disposal of dead or downer animals because of operational difficulties removing SRM. Estimates regarding the proportion of bovine mortalities disposed of via rendering range from about 17 percent to 45 percent (Informa Economics). For concentrated operations such as dairies or feedyards, it is safe to assume that rendering is a widely used means of mortality disposal. Of course renderers will only continue to collect dead animals if revenues (including collection fees) from doing so exceed costs. In a worst case scenario, assuming SRM could not feasibly be removed from dead animals, the SRM ban would mean that the rendering products from dead animals would have to be disposed of rather than sold. The resulting loss in revenue plus disposal cost provides an estimate of the increase in the collection fee that a renderer would require to maintain its margin. Using, for example, the case of a 1,000 pound animal that would yield 25 percent MBM and 25 percent tallow, the revenue loss at current prices would amount to approximately $57.75. The cost of disposing the rendering products would amount to $18.75 for a total of $76.50 per head.

This amount may in some cases, overestimate the disposal cost for an operation, since alternative means of disposal may be available at lower cost. As pointed out by Informa Economics (2004), those alternatives may involve significant environmental costs, but an examination of that issue is beyond the scope of this report.

5.4 Expanded Definition of SRM

The definition of SRM in other countries with BSE does not typically recognize a 30-month age cut-off for tissues such as brain and spinal cord. When SRM controls were first introduced in the United Kingdom in 1989, the definition included the brain, spinal cord, spleen, thymus, tonsils and intestines of bovine animals aged 6 months or over. Since then, the definition has been expanded many times as more was learned about the disease. As of October 2000, SRM is defined in all European Union countries to include the following tissues (DEFRA):

> *Skull including the brains and eyes, the tonsils, the spinal cord of animals aged over 12 months and the intestines from the duodenum to the rectum of bovine animals of all ages.*

The following tissues are also designated as SRMs in the United Kingdom and Portugal:

> *The entire head, excluding the tongue, including the brains, eyes, trigeminal ganglia and tonsils; the thymus; the spleen and spinal cord of animals aged over 6 months; and the vertebral column, including dorsal root ganglia, of animals aged over 30 months.*

A possible extension of current U.S. regulations would be to eliminate or reduce the 30-month age limit in the current definition of SRM. As noted above, the International Review Team recommended that the SRM definition be expanded "unless aggressive surveillance showed the BSE risk to be minimal." If indigenous BSE cases are discovered, it seems likely that this change would occur. Assuming SRM is banned from all animal feed, an expanded SRM definition would increase the cost of the regulation for under 30-month animals – i.e., from $2.16 per head to the estimate of $6.77 per head applicable for older animals.[23]

[21] *From the January 7, 2005 USDA By-product Drop Value report – tallow 15.25¢ per pound, MBM $157 per ton.*

[22] *Renderers will charge fees for SRM disposal. In Ireland for example, SRM disposal fees, which are passed back by packers to producers, are currently around $4 per head.*

[23] *Reducing the age limit might also reduce costs in packing plants that would no longer be required to age animals.*

5.5 Ban the Feeding of any Animal Protein to Ruminants

This measure, recommended by the International Review Team, would eliminate the remaining exemptions for mammalian protein in the 1997 feed ban (blocking feed pathway #3 in Figure 5.1). Ruminant feed rations accounted for about 567 million pounds of porcine MBM in 2000,[24] less than 10 percent of total MBM production (6.6 billion pounds), or about 5 percent of total animal protein (MBM, blood meal, poultry by-product meal, feather meal) production of about 11.2 billion pounds. Banning ruminant consumption of animal protein would therefore reduce demand for animal protein by about 5 percent. But, in order to estimate the impact on prices, one must account for the fact that animal protein meals such as MBM and blood meal are part of a larger market in protein meals that includes soybean meal (44 percent protein) and corn gluten meal (60 percent protein). In many rations, these alternative protein sources are close substitutes for MBM.

In the market for protein sources, soybean meal dominates MBM. Annual domestic feed consumption of MBM is around 5.7 billion pounds, while soybean meal consumption is more than 10 times greater at between 60 and 70 billion pounds.[25] Regression analysis estimated the following relationships between porcine and ruminant MBM prices and soybean meal price using monthly data:

Jan 1998 to Nov 2003 (after feed ban, pre BSE)

Ruminant MBM Price = 28.2 + 0.83 × Soymeal Price (R^2 =75 percent)

Porcine MBM Price = 41.1 + 0.85 × Soymeal Price (R^2 =67 percent)

These results illustrate the close relationship between prices for MBM and soybean meal, with variation in soymeal prices explaining between 67 percent and 75 percent of the variation in MBM prices.[26] This suggests that MBM and soybean meal effectively comprise a highly integrated market for protein. A ban on ruminant consumption of MBM would affect less than 1 percent of that protein market. Furthermore, rather than reducing overall demand by 1 percent, the measure would instead cause changes in the type of protein going to different segments of the market. Thus, the overall price impact would likely be small.

Given its high protein content (50 percent) MBM would continue to have a value comparable to soybean meal in pig and poultry rations. However, because the measure would eliminate a market niche for porcine MBM and presumably end the requirement to label ruminant MBM, its main impact is likely to be a reduction in the price premium for porcine MBM.

5.6 Ban on Feeding Ruminant Derived Protein to any Animal

Groups such as the Organic Consumers Association have lobbied for a complete ban on ruminant derived proteins. Their position is based on the argument that if ruminant proteins are available at attractive prices, producers will have an incentive to violate the feed-ban by feeding them to ruminants. Destruction of all protein products from ruminant rendering would eliminate pathways #1 and #2 in Figure 5.1 and reduce the available supply of MBM and blood meal.[27] The analysis here assumes that the fat products (tallow and grease) from ruminant rendering could continue to be marketed.

Eliminating ruminant proteins from the market imposes costs on the beef sector – a combination of the loss of revenues from sales of MBM and blood meal, plus the costs of disposal. Using current prices for MBM and blood meal ($157 per ton and $300 per ton respectively), we calculate the loss in by-product revenues for a 1,275-pound steer to be $9.65, and for a 1,100-pound cow to be $8.54. Adding disposal costs of $75 per ton for the rendered material increases the cost of this measure to $14.01 per steer or $12.35 per cow.

Animal protein from ruminants or mixed sources constitutes about 46 percent of total animal protein supply, which is about 5.2 billion pounds from a total supply of 11.2 billion pounds,[28] but only about 6.4 percent of the total protein supply including soybean meal. Nevertheless, a supply reduction of that magnitude could have a significant impact on prices depending on the elasticity of demand for animal protein. We could find no published estimate of that elasticity, however studies on the soybean meal

[24] *These estimates are from the 2001 Sparks report.*

[25] *Data from Soystats (http://www.soystats.com/). According to the Corn Refiners Association (www.corn.org), approximately 1 billion pounds of corn gluten meal were consumed domestically in 2000, with 1.6 billion pounds exported.*

[26] *Price coefficients in the regressions are statistically significant at the 1 percent level.*

[27] *A less stringent version of this policy would allow ruminant MBM in pet food, but not in food for farmed animals.*

[28] *These estimates are from the 2001 Sparks report.*

Table 5.1. *Costs of Existing and Proposed Feed Policy Options.*

Policy	Description	Cost per steer
1	1997 ruminant feed ban	$0.86 initially, $3.17 post BSE
2a	Blood meal: Impact of announcing the removal of the exemption.	$0.57
2b	Blood meal: Additional impact of actually removing the exemption.	$0.86
3	Ban SRM, as currently defined, from all animal feed.	$2.16
4	Expand definition of SRM to include brain, spinal cord, etc of all animals. SRM banned from all feed.	$6.77
5	Ban on feeding any animal protein to ruminants	Minimal impact, some feed cost increase
6	Ban on feeding ruminant protein to any farmed animals*	$14.01 + $4.50 feed cost increase
7	Ban on feeding any animal protein to any farmed animals[1]	$14.01 + $9.60 feed cost increase

[1] *Assumes ruminant derived tallow can be sold. If tallow from SRM (or expanded definition of SRM) is also banned, cost increases by $1.08 (or by $3.37).*

market suggest that demand is quite inelastic. Piggott et al. (2001) estimated elasticity of demand for soybean meal at -0.13, thus a 10 percent change in price would change quantity demanded by only 1.3 percent. If demand in the market for protein exhibits this level of price responsiveness (i.e. a price flexibility of 1 ÷ 0.13 = 7.7), it suggests that a 6.4 percent reduction in protein supply would result in approximately a 50 percent increase in price. The clear beneficiaries in that case would be suppliers of non-ruminant animal proteins and soybean meal, while higher feed costs would be borne by cattle producers. At current prices for soybean meal ($160 per ton) we estimate that a 50 percent price increase would add $4.50 to the feed cost for a typical steer.

5.7 Ban on Feeding any Animal Protein to Farmed Animals

A total ban on feeding animal protein to farmed animals would simulate feed policies currently in place in the European Union and Japan (eliminating all 4 of the feed pathways in Figure 5.1). In terms of revenue losses resulting from the inability to sell MBM and blood meal, and the costs of disposing of those products, the cost of this measure for cattle producers would be similar to that estimated above (i.e. $14.01 per steer or $12.35 per cow). The pork sector however, would suffer a loss in this scenario, while gains for producers of other protein meals would be larger.

Eliminating all animal derived protein would reduce total protein meal supply by approximately 13.6 percent. With an overall demand elasticity of -0.13 (as above) this supply reduction would lead to about a 100 percent increase in prices. At current prices, that would add $9.60 to the finishing cost for a typical steer.

5.8 Conclusion

As noted by Caswell and Sparling, because BSE is a new and relatively low probability risk, there is considerable uncertainty about the level of risk, about the efficacy of measures to mitigate that risk, and thus about the associated benefits of such measures. In our analysis, therefore, we estimate only the costs associated with the alternative policies and we do not attempt to quantify potential benefits.

The analysis suggests that, in terms of cost to the beef sector, a ban on feeding animal protein to ruminants would have a lesser impact than some of the other options. While it would result in some feed cost increases, we believe those would be less than the feed cost increases calculated in scenarios 5.6 and 5.7, which involve overall reductions in the supply of protein meals.

Impact on U.S. Beef Demand of Future BSE Cases

Fortunately for U.S. beef producers, U.S. consumers did not back away from beef following discovery of a single BSE case in late 2003. In fact, strong domestic beef demand, particularly during the first half of 2004, helped the beef industry weather the dramatic decline in export demand that occurred during 2004. Per capita retail beef consumption in the United States during 2004 totaled 66.1 pounds, an increase of 1.8 percent compared to 2003. The consumption increase occurred despite the fact that domestic beef production declined 6.4 percent from the prior year. The primary reason that domestic consumption increased at the same time that production declined was that U.S. beef exports during 2004 fell 82 percent below 2003's exports and beef imports rose 22 percent. Despite the modest rise in beef supplies facing U.S. consumers, the inflation adjusted price of Choice retail beef during 2004 was 5.7 percent higher than 2003's price. Since domestic consumers ate more beef and were willing to pay a higher price for the larger quantity, it means domestic beef demand increased compared to 2003. Beef demand index calculations indicate U.S. beef demand during 2004 increased about 7.6 percent above 2003's demand. Despite the apparent strength in U.S. consumers' demand for beef during 2004, concerns exist regarding how U.S. consumers might react if additional BSE cases are identified.

In particular, the increase in surveillance testing for BSE in response to the discovery of the Washington state case increases the probability that an indigenous case of the disease will be detected in the United States, if it is in fact present. A specific objective of this study is to investigate how U.S. beef consumers would respond to such a discovery, and whether that response would be influenced by the number of cases found. This section describes a consumer survey used to estimate the potential consumer responses to additional BSE cases.

6.1 Consumer Survey

A survey was mailed to residents of Kansas (498), California (1,000), and New York (1,000) with a follow-up mailing to non-respondents after a 3-week interval. We chose to do a regional targeted survey in order to investigate potential regional differences in consumers' reactions. The first section of the survey asked about beef consumption, about the respondent's familiarity with mad cow disease, and whether respondents had changed their meat consumption habits as a result of the discovery of mad cow disease in the United States.

To examine the potential impact of additional cases of BSE, we constructed two scenarios. In one, we asked respondents *whether their beef consumption would change* if a single additional case of BSE were discovered in a U.S.-born cow in Montana. In the second scenario, we asked a similar question, this time contingent on the discovery of 20 additional cases of the disease in different parts of the country. For these scenarios, respondents were asked to indicate their response from the following options:

_____ *No, our beef consumption would probably* ***remain as it is now****.*

_____ *Yes, we would probably consume* ***less beef*** *than we do now.*

_____ *Yes, we would probably* ***stop consuming beef*** *altogether.*

_____ *Yes, we would probably consume* ***more beef*** *than we do now if its price fell.*

We used three versions of the survey, one for each of the two scenarios described above, and a third version that included both scenarios. The objective of the third version was to investigate the sensitivity of responses to the framing of the question – i.e., whether it was presented with or without an alternative scenario.

6.2 Survey Results

Of 2,498 surveys mailed, 198 were returned by the post office and 31 were returned by recipients choosing not to participate. A total of 878 consumers responded yielding a response rate of 35 percent. Of those, 856

Table 6.1. *Surveys Measuring Consumer Reaction to BSE.*

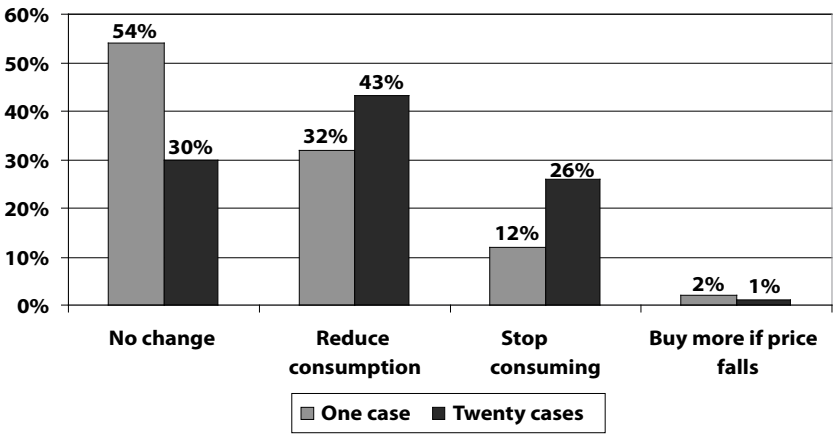
Name	Date	Method	N	Results
CNN/ USA Today/ Gallup	Jan 2-5	Telephone	1,029	17% reduced or stopped consuming certain types of meat
WSJ / Harris Poll	Jan 6-8	Online	2,378	21% will change eating habits, 16% will reduce beef consumption, 3.5% will stop eating beef
Harvard	Jan 7-11	Telephone	1,015	18% concerned about getting mad cow disease, 22% changed beef consumption[1], 7% stopped eating beef[1]
Rutgers	Jan 15-18	Telephone	1,001	14% eating less beef, 5% stopped consuming beef[2]
BIGresearch	Jan 2004	Telephone	8,600	29% plan to cut back beef purchases

[1] *respondent or member of respondent's family*
[2] *75% of these would resume consumption within 6 months if no more cases were found*

responses were complete enough for analysis. Forty-seven percent of respondents were male and the median age of the sample was 55 years. Median education level was "some college" and the median income between $50,000 and $70,000. On average, families consumed beef 5.3 times per month at-home, and 3.6 times per month away-from-home.

Ninety-nine percent of respondents had heard of mad cow disease, but 37 percent knew very little about it. When asked whether they were concerned about mad cow disease, only 21 percent were quite-a-bit-concerned or very-concerned. These results are similar to other surveys. For example in a CNN/*USA Today*/Gallup survey only one in six respondents worried that they or a family member might contract the disease.

Figure 6.1. *Response to one or 20 Additional Cases of BSE (Independent Samples).*



6.3 Response to the Initial BSE Case

Seventy-seven percent of respondents indicated that their consumption had not changed in response to the first case of BSE. Of those indicating that their consumption had changed, 18 percent were consuming less ground beef or burgers, 10 percent were consuming fewer hot dogs and 11 percent were consuming less steak. Comparison of responses from the different target regions indicated that respondents from New York and California were 10 percent and 14.5 percent more likely to indicate a reduction in consumption than respondents from Kansas (Blake). The overall proportion of respondents indicating reduced beef consumption is similar to that reported in other surveys conducted in the months following the BSE discovery (Table 6.1).

6.4 Response to Additional Cases of BSE

As described above, we used different versions of the survey to investigate response to one or 20 cases of BSE. In the one-case scenario, 54 percent indicated that consumption would not change, 32 percent indicated their consumption would fall, and 12 percent indicated they would stop consuming beef (Figure 6.1). But given the discrepancy between survey responses (indicating significantly reduced demand) and actual market behavior (demand actually strengthened in the first quarter of 2004) following the first BSE case, these responses cannot be interpreted as predicting a proportionate reduction in beef demand.

So, what do our results suggest about the influence of another BSE case on beef demand? Unfortunately, with only one observation on the relationship between the change in demand and that predicted by surveys, we cannot estimate a unique relationship between them, one that might allow us to calibrate our

survey responses and thus predict a change in demand. However, the fact that the proportions in our reduce/eliminate categories (32 percent and 12 percent respectively) are significantly larger than those reported in surveys assessing the response to the initial case (e.g. WSJ/Harris, 16 percent reduced, 3.5 percent stopped) suggests that a second case would have a bigger impact on beef demand than the initial case. To what extent is impossible to say, given the potential for bias in these responses and the fact that we have no way to calibrate our results.

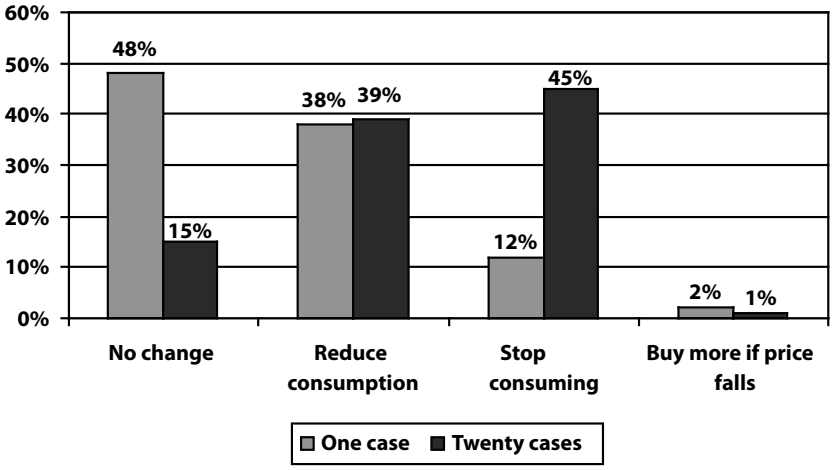
Figure 6.1 also suggests that the reaction to 20 cases of BSE would be significantly greater than the reaction to a single additional case. In the 20-case scenario, only 30 percent of respondents said their consumption would not change, 43 percent indicated consumption would fall, and 26 percent indicated they would stop consuming beef. While these responses presumably exaggerate what the actual response would be, the comparison does suggest that multiple cases would have a significantly greater impact than another isolated case.

In the third version of the survey we used both disease scenarios to examine the effect of framing the 20-case scenario alongside the single-case. Responses to the single-case scenario were similar whether the question was posed in isolation (Figure 6.1) or with the 20-case scenario (Figure 6.2). However, responses to the 20-case scenario are dramatically different depending on whether the question is framed with or without the single-case scenario.

Figure 6.2 shows that when both scenarios were used in the same survey, 45 percent of respondents say they would stop consuming beef if 20 cases of BSE were discovered. In response to the same question presented as the only scenario, only 26 percent indicated they would stop consuming beef (Figure 6.1). Thus, the effect of framing the 20-case question alongside the single-case question causes respondents to indicate a more negative reaction. Ordered probit analysis of these responses found that this framing effect was statistically significant (Blake).[29]

Because framing matters then, it is reasonable to ask whether other features of the survey design, inclusions or omissions, might have influenced responses. Thus, had we provided more information about the risk context, for example by informing respondents that there are about 100 million cattle in the United States, the discovery of a single case framed as one out of such a large population may have led to many more respondents indicating that their consumption would be unchanged.

Figure 6.2. *Response to One or 20 Additional Cases of BSE (within Sample).*



6.5 Conclusions Regarding Consumer Response to Future BSE Cases

Market data suggests that the first case of BSE in the United States had minimal impact on domestic demand for beef, notwithstanding survey results that suggested the possibility of up to a 20 percent drop in consumption. Given the disconnect between survey projections and market behavior, results from our survey, in which we attempt to assess the potential impact on beef consumption of additional BSE discoveries, are difficult to interpret. A comparison of our results with those of surveys conducted after the initial case suggests, however, that new BSE cases could have a more negative impact on demand than did the first case. Our results also indicate that the impact of multiple (in this case 20) cases would be significantly greater than that of a single additional case. However, given the various biases to which survey responses are subject, and effects related to how questions are framed, our results cannot be interpreted with any confidence to predict a significant reduction in beef demand if new cases of BSE are found.

[29] *The analysis also suggested that females would be significantly more likely to reduce consumption than males, and that respondents in New York and California were more likely to indicate they would reduce consumption than residents of Kansas.*

Regulatory Policy Alternatives

Since the BSE case was identified in Washington state, and regulatory policies described in Section 2 and examined in Section 4 were put into place, associations representing producers, processors, and consumers as well as firms involved in various industry activities have presented and defended numerous alternative policies. This section identifies several widely discussed alternative policies and presents cost estimates associated with each. It is critical to recognize that no policy, if enacted, would likely result in only the explicit direct costs associated with it. This is because of the dynamic nature of the environment in which beef and beef products are processed and sold. For example, a policy that alters the definition of SRMs might allow a certain product back into the market and, thus, result in an increase (or potential increase) in revenue for meat packers and processors. However, if the change in SRM definition violated BSE prevention standards of a country currently importing U.S. beef products, that country might reduce or eliminate trade with the United States because of the policy. This cost of lost trade also should be considered in any analysis of such a hypothetical policy if an accurate economic impact of the policy is to be estimated.

Relationships between different market and regulatory factors make estimating economic impacts of policy changes challenging. This report only considers explicit costs associated with narrowly defined policy alternatives. Any combination of these alternatives can be used to construct a broader policy strategy. The cost of the broad policy strategy is the sum of the costs of individual parts. If it is assumed that a portion of the broad policy impacts trade by re-opening or closing trade with a certain country, this impact can be incorporated using the values of beef trade with certain countries reported in Section 3. This approach provides a flexible tool to analyze the direct economic impact of alternative policies.[30]

7.1 Testing for BSE

The issue of testing for BSE has been a topic of considerable discussion and disagreement. Some level of surveillance for BSE via testing is generally considered necessary to determine the incidence of BSE in the beef herd and thereby guide policies for managing the disease. However, the extent of BSE testing necessary to meet the goals of all concerned parties has been contested. Based on discussions with industry participants, government regulatory agencies, and a survey of news media, we have identified four popular alternative BSE testing policies:

1. Test all cattle slaughtered in the United States
2. Allow voluntary testing of all slaughter cattle by slaughter/processing firms
3. Maintain current surveillance level
4. Reduce surveillance to levels comparable to those in 2003

One of the most visible debates regarding BSE regulation by the federal government has been over the issue of who is qualified to administer a test for BSE on slaughter cattle. The question has sharply divided the beef packing industry and provoked strong responses from consumer advocacy groups. Some cattle slaughter firms have indicated a desire to test all cattle they slaughter for BSE using the rapid test approved by USDA. The driving motivation behind this desire was the assertion that if a firm could show that 100 percent of kill tested negative for BSE, countries, like Japan, that have closed their borders to U.S. beef would be inclined to resume importation of beef products from the plant that is testing all animals. After 7 months of debate, USDA gave a final answer of "no" to all requests for permission to privately test cattle for BSE. Many reasons have been cited by USDA and its branches as to why voluntary testing was not allowed. The primary tone of the rejection, however, was that USDA viewed the rapid test as a surveillance tool and for slaughter firms to use it as a marketing tool would imply a consumer safety aspect that is not scientifically warranted (Vina).

There are many details surrounding this debate and parties from both sides have made extensive arguments. We do not attempt to present these details here or resolve the debate but, rather we refer the reader to Vina for a

[30] *BSE policies have been developed with the intent of reducing the risk of the spread of BSE through the U.S. beef herd and the risk of consumer exposure to BSE-infected material, should the disease be present in the U.S. In our analysis of policy alternatives we do not address the impact on the risk of exposure of animals or humans to BSE but, rather, focus on the economic impacts of the policies. Sources for the risk management impact of current and some alternative strategies include the Harvard Study (Cohen, et. al.) and the FSIS Preliminary Analysis.*

Table 7.1. *Estimated Revenue Gains Less BSE Testing Costs for Various Testing and Beef Export Scenarios.*[1]

% of U.S. cattle slaughter tested for BSE	% of Japanese & South Korean beef and offal export markets regained[2]					
	0%	10%	25%	50%	75%	100%
	Wholesale Revenue Per Head					
0%	$0.00	$5.36	$13.48	$27.22	$41.22	$55.49
10%	$(1.75)	$3.61	$11.73	$25.47	$39.47	$53.74
25%	$(4.38)	$0.98	$9.10	$22.84	$36.84	$51.11
50%	$(8.75)	$(3.39)	$4.73	$18.47	$32.47	$46.74
75%	$(13.13)	$(7.77)	$0.35	$14.09	$28.09	$42.36
100%	$(17.50)	$(12.14)	$(4.02)	$9.72	$23.72	$37.99

[1] *Assumes BSE tests cost $17.50 per head tested. Revenue gains based upon 2004 U.S. commercial cattle slaughter of 32.7 million head.*

[2] *Export market percentages are a percentage of 2003 exports.*

legal summary of the situation as it related to Creekstone Premium Beef.

Even with the apparently final ruling of the USDA, the issue of private testing remains a topic of interest. However, there is strong opposition to such a policy. One often-reported argument is that voluntary testing would ultimately lead to all firms needing to test for BSE to satisfy foreign (and possibly domestic) customers. Since it is impossible to know how many firms would test if voluntary testing were allowed, we do not estimate a cost for that policy option. Rather, we consider the cost of testing and examine several possible testing scenarios.

The cost of the USDA-approved rapid test is $12 to $15 per animal tested with approximately $3 to $5 labor per head involved, assuming the testing is on-site. This translates into $15 to $20 variable cost of testing per head. This cost ignores the investment needed to place a working testing facility in a slaughter plant. This would almost certainly be necessary for a firm to keep up with testing all cattle slaughtered. This cost would also vary substantially from firm-to-firm depending on the degree to which facilities would need to be altered or remodeled to accommodate the testing facility. Based on this analysis, the total variable cost of testing all cattle slaughtered in the United States in 2004 would have been approximately $640 million.

Some beef industry participants have argued that mandatory testing is an attractive policy alternative. This is especially true if one assumes that testing would reopen markets and thus, regain the $1.4 billion of beef exports to Japan that were shipped in 2003. Another popular assumption in evaluating this alternative is that mandatory testing would make many current regulatory measures unnecessary. One or both of these assumptions have commonly been made in many analyses evaluating the issue of voluntary or mandatory testing. However, we are not convinced that the assumptions are warranted. Government regulatory agencies have remained adamant that current policies are based on food safety science and will not be altered based solely on testing protocol designed for surveillance purposes. Furthermore, we do not know whether, or the extent to which, U.S. testing slaughter cattle for BSE would regain access to the Japanese and South Korean beef export markets.

However, it is useful to consider a range of potential outcomes if the United States were to alter its BSE testing program. Table 7.1 provides estimates of potential outcomes if the United States systematically tested slaughter cattle for BSE. The data in the table are estimated net wholesale revenue gains per head (estimated per head gross revenue gain minus per head BSE testing costs) for each of 36 different scenarios. Six different levels of BSE testing are specified, ranging from 0 to 100 percent. Similarly, six different levels of exports to Japan and South Korea are also considered. The export levels range from 0 (i.e., both countries continue to ban imports of U.S. beef) to 100 percent (i.e., both countries resume imports, measured as a percentage of U.S. production, at 2003 levels). The estimates in Table 7.1 are calculated based on the estimated gross wholesale revenue gains reported previously in Section 3.9. BSE testing costs of $17.50 per head tested are subtracted from expected gross revenue gains

to calculate the potential net gains. Note that the cost estimate for testing does not include capital investments required to install testing facilities in slaughter plants. The base, no testing of slaughter animals for BSE, results in no cost change. The next scenario assumes that the United States tests 10 percent of all cattle slaughtered. Thus, the cost per head spread across all cattle slaughtered during 2004 would equal $1.75 per head (0.10 × $17.50). Cost estimates for testing 25, 50, 75, and 100 percent of all cattle slaughtered are derived in the same manner.

Results of this scenario analysis confirm that regaining access to the Japanese and South Korean export markets is important to the U.S. beef industry. If the United States regains full access to both of these markets without bearing the cost of testing for BSE, the wholesale revenue gain would range from $45 to $66 per head (or about $55 per head). Conversely, if the United States adopts a BSE testing strategy, but does not regain access to these key markets, the net loss would be $17.50 per head if all U.S. cattle are tested. Estimated revenue gains approximately equal estimated testing costs if the U.S. regains about 25 percent of the Japanese and South Korean export markets and the United States tests approximately 75 percent of commercial cattle slaughter. Estimated revenue gains exceed testing costs if U.S. exports to Japan and South Korea surpass 25 percent of 2003 levels.

Note that voluntary testing by a single, small firm would provide little or no benefit to producers because the increase in the derived demand for cattle generated from such a small-scale increase in exports would have an insignificant impact on domestic cattle prices. The policy could, however, result in significant profits for a firm engaged in testing, at least in the short run, if testing opened up additional markets for a firm's beef products. If additional market access is obtained through BSE testing, more firms would be attracted to testing and domestic cattle prices would increase.

When evaluating testing criteria, it is crucial to consider the non-explicit costs that make 100 percent testing more costly than just the physical testing expense. One prominent potential cost of mandatory testing is the economic costs associated with possible false positive test results, which are expected to occur with the sensitive rapid test. According to Daniel Goldstein of Bloomberg News, Bio-Rad, manufacturer of the rapid test, expects about 5 false positives (USDA reports a positive rapid test as inconclusive) in a testing sample of 250,000 (Cattle Buyer's Weekly).

As an example of the potential impact of these rare but reoccurring false positive test results, consider the impact of the most recent positive rapid test result reported. On November 18, 2004 USDA/APHIS announced the third "inconclusive" rapid test result since beginning the enhanced surveillance program in June of 2004. This announcement came after an earlier revision of USDA policy indicated that inconclusive tests would not be made public. Rather there would only be a public announcement if the "gold-standard" immunohistochemistry (IHC) test used to verify "inconclusive" rapid test results turned out to be positive. Apparently, USDA viewed this inconclusive result as being of "a higher order" than previous inconclusive tests (the test was repeated in duplicate and the inconclusive result was apparently consistent in both tests) and therefore, made the results public. This was followed by later press reports that, according to Bio-Rad, there is a 95 percent probability that a positive IHC test would follow such an inconclusive rapid test result. The official announcement was released minutes before the futures market opened for trading. Most live cattle futures contracts opened around $2 per hundredweight lower than the previous day's close and many moved limit down that day. In the cash market for live cattle, markets that week were still developing. However, very light sales in the following days were likely the short-run cash market reaction to the news. Packers are not likely to be very aggressive about buying slaughter cattle when such a potentially market damaging event is pending with unknown results.

The initial USDA/APHIS announcement carefully explained that the inconclusive test result did not mean that the United States had another case of BSE. Nonetheless, the possibility of another positive test result causes substantial market uncertainty. The market

reaction to these announcements, as seen on November 18, may be short term in nature but are disruptive and costly to the industry. Additionally, we do not know the impact that such negative publicity has on consumer confidence, but most research indicates that negative food safety information has more impact than countervailing positive information. This cost is difficult to quantify, but could be substantial and is one of the reasons that voluntary and universal testing are not attractive options to many beef industry participants.

Continuing a BSE surveillance method similar to what is in place now is another policy alternative. Although the beef industry alone does not pay for current BSE testing directly, it is a cost incurred by government agencies relying on federal tax dollars, so it is a relevant public cost. Currently, only APHIS personnel are allowed to collect samples and these are tested at designated laboratories. It is the responsibility of APHIS employees to secure a large number of tests that focus on suspect animals (mainly non-ambulatory cattle). The samples are collected at slaughter plants, rendering plants, and other processing facilities (e.g., pet food manufacturers). This approach has resulted in the collection and testing of approximately 167,000 samples between June 1, 2004 and January 2, 2005.

If we assume this rate of testing is sustainable annually, then APHIS could plan to test about 286,000 cattle each year. The testing cost alone for this program would be between $4.29 and $5.72 million, including labor directly related to administering the test. The cost of collecting samples is also substantial, but we do not estimate that cost here.

Many have suggested that at the end of the current increased surveillance strategy (scheduled to be sometime in the latter half of 2005), if no cases of BSE have been identified, testing could safely be scaled back. One guideline for such a reduction would be the level of testing prior to the U.S. BSE incident. In fiscal year 2003, APHIS tested approximately 20,000 head of cattle for BSE. This level of testing would translate into a cost of $300,000 to $400,000. Under this scenario, the cost of labor for sample collection would be much lower than under the current testing regime as APHIS employees could meet this testing quota with considerably less effort.

We should mention again that it is important to note in assessing costs of any BSE testing rule on tax payers, consumers, processors, and producers whether any or all other costs associated with managing BSE would be reduced or forgone. That is, if all other regulatory costs were removed and all international trade re-opened for beef, net costs associated with BSE testing would likely be more than offset by reduced costs and increased product values. However, if any of these other costs are still incurred, they should be added to the cost of BSE testing to obtain an overall economic impact. That is, testing alone should be considered one incremental cost of the broader based policy.

As an example, consider the implementation of a policy that maintains the current level of surveillance for BSE. Further, assume that, given this level of continued surveillance, FSIS approves the small intestine of U.S. beef cattle for human consumption. Currently, the Mexican border is open to beef products for those participating in the Mexico BEV program, so packers could realistically access these markets and realize prices near their 2003 level. As a final assumption, leave all other regulatory and foreign export components unchanged. The estimates of this study can be used to evaluate the annual economic impact of such a hypothetical policy change as follows:

Policy Component	Average Cost Estimate (million)
Use Current Surveillance Plan	($5.0)
Allow small intestine in food supply	$96.1
Cost of restoring jobs related to small intestine processing	($33.4)
Total Net Impact of Policy Change	$57.7

Viewing the policy change in this way allows us to infer that there would be a net gain of $57.7 million (using 2004 cattle numbers). Depending on who bears the cost of testing, this figure may or may not represent the direct benefits to beef packers of such

a policy change. This example illustrates how a combination of policy options and surrounding assumptions can be used to arrive at the cost or benefit of a given policy strategy.

7.2 Non-ambulatory Animals

One component of the FSIS Interim Final Rules that has met with much industry criticism is condemnation of all non-ambulatory cattle, defined as cattle that cannot rise and walk by their own power. Many beef packers and trade groups contend that a reasonable distinction can be made between animals that are non-ambulatory for reasons that would make them suspect for BSE (e.g., a nervous system disorder) and those that are non-ambulatory for purely physical reasons (e.g., a broken leg). They argue that the latter category should not be condemned from the food supply. Proponents of excluding all non-ambulatory cattle from the food supply counter that once an animal is non-ambulatory due to an injury it is impossible to determine exactly why the animal initially sustained the injury. They argue that injured non-ambulatory cattle may have become such because of central nervous system symptoms or other disorders that could be related to health. In analyzing this policy we do not attempt to settle this debate. However, we can estimate the impact of this portion of the policy based on results from Section 4.

Not all of the non-ambulatory cattle condemned in 2004 would have been slaughtered and processed even if allowed by FSIS. Prior to the current Interim Final Rules, non-ambulatory animals had to pass certain inspection criteria to be allowed into the food supply. In their Preliminary Analysis, FSIS assumed that approximately 74 percent of all non-ambulatory cattle would be slaughtered (i.e., passed the previous inspection criteria), if not for the Interim Final Rule. Based on interviews with industry personnel, we believe that the Interim Final Rules have brought about such a change in procurement practices that almost all the non-ambulatory cattle condemned in 2004 would have passed standards for slaughter prior to the Interim Final Rules. Assuming this portion is 95 percent, the benefit to allowing non-ambulatory cattle into the food supply would have been $63,232,000 for 2004. As in Section 4, we note that this value is likely an upper estimate because many of these cattle would have been processed through channels other than those typically used.

7.3 Small Intestine

Several products were deemed inedible by the FSIS Interim Final Rules. However, many of those were not highly valued, especially on the domestic market, and were supplied by a small portion of packers that had identified a niche for such products. One exception to this is the small intestine. The distal ileum portion of the small intestine was identified as a SRM. To ensure the complete removal of the distal ileum, the entire small intestine was condemned from the food supply. Many in the beef industry have requested that this portion of the rule be reconsidered. Specifically, most requests are that only the distal ileum portion of the intestine be condemned. This would allow the majority of the small intestine to be sold. The debate surrounding this decision centers on the ability or inability of packers to correctly identify and completely remove the distal ileum from the rest of the small intestine. Beef industry representatives claim that this can be done with reasonable ease while FSIS officials are not convinced that this is the case. Given the attention devoted to this issue by the industry, we estimate the impact of a policy change that would allow only the small intestine (minus the distal ileum) into the food supply.

Based on the calculations in Section 4, allowing the small intestine into the food supply would potentially increase revenue for packers by $94 million. As noted in Section 4, this amount assumes the selling prices for small intestines observed in 2003 would be attainable. Given that much of the small intestine was previously exported to Mexico and that trade with Mexico is now possible for firms certified through the Agricultural Marketing Service (AMS) beef export verification (BEV) program, a large amount of intestine could be sold for prices comparable to those of 2003. As noted in Section 4, higher-priced small intestine was also shipped to Japan. Therefore, if Japanese markets remain closed, this increase in revenue may be less, since its calculation is based on prices from a period when these markets were open.

7.4 Animal Identification

One strategy that some have suggested to improve supply chain management and provide customers with increased assurance of animal traceability is to adopt a mandated animal identification system. The basic idea of a tracing system is to create and maintain an "information trail" that closely follows the path taken by the physical product being monitored. Defining traceability is difficult as traceability systems are often unique and can operate in a number of different ways with a range of objectives. The breadth, depth, and precision of a traceability system are each carefully selected to help achieve the objectives of the system (USDA 2004). Numerous benefits, most of which are not directly related to BSE concerns, would accrue to the industry (e.g., improved animal health surveillance, and information flow, and more intensive product traceability for food safety concerns) if the United States were to adopt a mandatory animal identification system. However, one potential benefit of animal identification relevant to BSE concerns is animal age verification assuming the tracking system maintained such a record. Conditions set forth by Japan in recent trade negotiations include allowing only products from cattle less than 21 months old for import, making this age verification information immediately valuable to the beef industry. In addition, an animal identification that tracks every premise and dates at that premise in which an animal has resided would help assure customers that if a BSE incident were discovered, all cattle the infected animal was raised with could be quickly identified and traced to isolate potential related incidence of the problem. The value of this kind of traceability has been demonstrated in the instance of the Washington state BSE case. Timely proof that the animal originated from Canada eased many concerns about the incidence of BSE in the U.S. beef herd and could have reduced the impact of the situation on consumer confidence. Due to these relationships, the current BSE situation has accelerated the adoption of a mandated animal identification program in the United States.

Animal identification breadth and depth can vary widely, as can possible costs of such a system. Further, because the benefits of animal identification accrue to so many segments of the industry and are not always related to BSE concerns, a cost-benefit analysis of animal identification is not conducted here. Nonetheless, animal mandatory identification may have an important role in managing BSE concerns. A comprehensive cost-benefit analysis of such a system for animal disease prevention alone has been done elsewhere (see Disney et al. 2001). Results suggest sizable benefits relative to costs, but they depend heavily on the time frame over which an incident such as appearance of foot-and-mouth disease (the disease which is most often cited as being more controllable in the presence of animal identification) might occur.

References

BIGresearch. "Most Consumers Believe U.S. Beef is Safe." Consumer Intentions and Actions Survey, January 2004 http://www.bigresearch.com/

Caswell, J. and D.Sparling. "Risk management in the Integrated NAFTA Market: Lessons from the Case of BSE." Paper presented at the First Annual North American Agrifood Market Integration Workshop. Cancun, Mexico, May 2004.

CNN/USA Today/Gallup Survey. "Gallup Survey Finds Some Consumer Concern Over BSE." Summary available via Minnesota Beef Council www.mnbeef.org , January 2004

Cohen, J., K. Duggar, G. Gray, S. Kreindel, H. Abdelrahman, T. Habtemariam, D. Oryang, B. Tameru. "Evaluation of the Potential for Bovine Spongiform Encephalopathy in the United States." Harvard Center for Risk Analysis and Center for Computational Epidemiology, Tuskegee University, November 2001. Revised October 2003.

Corn Refiners Association. 2001 Corn Annual. Available at www.corn.org

DEFRA www.defra.gov.uk/animalh/bse/publichealth/srm.html

Disney, W.T., J.W. Green, K.W. Forsythe, J.F. Wiemers, and S. Weber "Benefit-Cost Analysis of Animal Identification for Disease Prevention and Control." Rev. Sci. Tech. Off. Int. Epiz., 2001, 20 (2), 385-405. Available at: http://www.oie.int/eng/publicat/rt/2002/DISNEY.PDF

Eenoo, E. and Purcell, W. "Economics of Export Demand for U.S. Beef." Research Institute on Livestock Pricing, Virginia Tech University. April 2000. www.aaec.vt.edu/rilp

Food and Drug Administration News Release. "Mad Cow Survey." February 2004. Available at: http://www.hsph.harvard.edu/press/releases/blendon/mad_cow_topline.doc

Food Safety Inspection System (FSIS). "Preliminary Analysis of Interim Final Rules and an Interpretive Rule to Prevent the BSE Agent From Entering the U.S. Food Supply." FSIS report on the Costs and Benefits of BSE Ineterim Rules.

Fox, John A. and Hikaru Hanawa Peterson. "Risks and implications of bovine spongiform encephalopathy for the United States: insights from other countries." *Food Policy*, 29(2004): 45-60.

Franco, Don A. "BSE and the Safety of Beef: A Perspective." *Food Safety Magazine*, Volume 10, No. 3 (June/July 2004). Available at: http://www.foodsafetymagazine.com/issues/0406/colguest0406.htm.

Hallman, William K., Brian J. Schilling and Calum G. Turvey. "Public Perceptions and Responses to Mad Cow Disease: A National Survey of Americans." Food Policy Institute, Rutgers University. February 2004. www.foodpolicyinstitute.org

Harvard School of Public Health. Project on the Public and Biological Security

Informa Economics, Inc. *An Economic and Environmental Assessment of Eliminating Specified Risk Material and Cattle Mortalities from Existing Markets*. Report prepared for the National Renderers Association, August 2004

Kay, S. "Result Renews Debate About Announcements." Cattle Buyer's Weekly, November 29, 2004.

Livestock Marketing Information Center. Miscellaneous tables. Lakewood, CO. www.lmic.info.

Marsh, J. "U.S. Beef Trade and Price Relationships with Japan, Canada, and Mexico." Policy Issues Paper No. 12, Montana State University. December 1999.

Mintert, J. "Beef Demand Increased in '04, But Growth Slowed During 4th Quarter." In The Cattle Markets. Livestock Marketing Information Center, Lakewood, CO. January 13, 2005.

Piggott, N., M. Wohlgenant, and K. Zering. "Analysis of the Economic Importance of Changes in Soybean Use." Soy/Swine Nutrient Research Program, National Soybean Research Laboratory, University of Illinois. November 2001.

Priondata.org "Specified Risk Material (SRM)" Accessed, Dec 2004 at http://www.priondata.org/data/A_SRM.html

Pruisner, Stanley B. Prions. *Scientific American*, October 1984.

Purcell, W. "A Primer On Beef Demand." Research Institute on Livestock Pricing, Virginia Tech University. April 1998. www.aaec.vt.edu/rilp

Sparks Companies, Inc. *The Rendering Industry: Economic Impact of Future Feeding Regulations*. Report prepared for the National Renderers Association, June 2001

Spongiform Encephalopathy Advisory Committee (SEAC). Statement of March 20, 1996.

U.S. Department of Agriculture (USDA), Economic Research Service. "Traceability in the U.S. Food Supply: Economic Theory and Industry Studies." Agricultural Economic Report Number 830. by E. Golan, B. Krissoff, F. Kuchler, L. Calvin, K. Nelson, and G. Price. 2004

U.S. Department of Agriculture. "USDA By-Product Drop Value (Steer), NW_LS441." Agriculture Marketing Service, Miscellaneous issues, 2003-2004.

U.S. Department of Agriculture. Foreign Agricultural Service. "FASOnline." www.fas.usda.gov/ustrade

U.S. Department of Agriculture. "Report on Measures Related to Bovine Spongiform Encephalopathy (BSE) in the United States." February 2, 2004. Available at www.aphis.usda.gov

U.S. Meat Export Federation. "Methodology and Results of the Value of Beef Exports Analysis". March 2002, Denver, CO.

Vina, Stephen R. "The Private Testing of Mad Cow Disease: Legal Issues." Congressional Research Service Report for Congress. July 1, 2004. Available at: http://www.ncseonline.org/NLE/CRS/abstract.cfm?NLEid=53402.

Wall Street Journal Online/ Harris Interactive Health-Care Poll. "One-Fifth of U.S. Adults say Fear of Mad Cow Disease Will Affect What and Where They Eat." Volume 3, January 13, 2004. http://www.harrisinteractive.com/news/newsletters_wsj.asp

Zhou, D. "Import Demand for U.S. Beef By-Products and Effects on Domestic By-Products and Effects on Domestic By-Product and Live Cattle Prices". May 2000, Montana State University, Bozeman, MT.

The World Wide Web links on this page were accurate when the authors created this document, they cannot guarantee that the links will remain active.

Appendix 1

Timeline of Major Bovine Spongiform Encephalopathy (BSE) Events.

Date	Event	Comments
November 1986	BSE became a legally reported disease in the United States	The United States was the first country in the world to take action in recognizing the threat of BSE to animal health
December 1986	BSE officially identified as a bovine Transmittable Spongiform Encephalopathy (TSE)	Since an initial case in 1984, several cases had arisen in the United Kingdom by this point in time.
December 1987	Epidemiologists link feeding contaminated meat and bone meal (MBM) to spread of BSE	There is by no means complete agreement that BSE spreads through MBM, however accumulating evidence makes this conclusion one of the most likely.
1988	USDA facilitated a standing committee to review literature, invite experts, cooperate with British researchers, and conduct ongoing research regarding BSE	
1989	USDA established an emergency ban on importation of all ruminants, bovine semen, embryos, and meat and bone meal (MBM) from the U.K.	
1989	U.S. established policies for submission of tissue from "BSE suspect" cases	
1990	USDA began a BSE education program about the pathology and clinical manifestations of the disease	
1990	USDA established the beginnings of a BSE surveillance program that included a traceback system for cattle imported from the U.K.	The United States seems to be the first country to implement an active testing regime before finding a domestic case BSE.
1990	U.S. Food and Drug Administration (FDA) established a BSE task force	
1991	USDA conducts BSE risk analysis	
December 6, 1991	USDA enacts formal policy to restrict importation of all high-risk products form countries with known cases of BSE	
1993	USDA updated the 1991 risk analysis and expanded BSE surveillance to include non-ambulatory ("downer") cattle	It seems that some downers were being tested since 1990, but the formal policy was put in place in 1993.
1993	A beef cow imported from to Canada from the United Kingdom tested positive for BSE.	
1994	USDA implemented immunohistochemistry (IHC) testing for BSE	Today, an IHC-type test is recognized by many as the "gold standard" test in determining BSE.
March 10, 1996	British government announced possible link between BSE and 10 new cases of new variant Creutzfeld-Jacob Disease (vCJD).	
1996	USDA revised the 1991/1993 risk analysis	
1997	FDA bans all high risk mammalian products from animal feed	Some products given exceptions were blood and gelatin.
1997	USDA bans imports of live animals and high risk bovine products from all European countries	

Date	Event	Comments
1998	USDA enters into a cooperative agreement with Harvard University to analyze and evaluate the potential of occurrence and transmission of BSE in U.S. cattle and the risk to human health in the United States from BSE	
1999	USDA increases sample collection in BSE surveillance	At this point, the USDA was collecting a sample five times greater than that recommended by OIE.
December 7, 2000	USDA banned import of all rendered animal products from Europe, regardless of species	
November 26, 2001	Harvard Center for Risk Analysis with support from Tuskegee University releasee the BSE Risk Assessment that began three years earlier.	This study concluded that the United States is highly resistant to the introduction of BSE and that BSE is highly unlikely to become established in the nited States. The authors have found that this report is perhaps the most widely-cited study in recent BSE-related publications dealing with risks of the disease.
2001	USDA altered surveillance to account for regional differences across the country and effectively doubled the planned sample size for 2002 relative to 2001	
May 20, 2003	It is reported that an Alberta beef cow tested positive for BSE	The USDA responded by banning imports of live cattle and all beef products from Cananda.
August 2003	USDA announced plans to allow certain "low risk" beef products to be imported from Canada.	
December 23, 2003	The "presumptive positive" BSE test of a dairy cow in Washington state is announced. Following tests in the United Kingdom would confirm the cow was BSE-positive.	Almost immediately, 53 countries stopped import of beef and beef products from the United States
December 30, 2003	USDA announces new precautionary measures to protect the U.S. beef herd and food supply from BSE. These interim final rules go into effect January 12, 2004	See the text of this report for details on the interim final rules.
January 26, 2004	FDA announces that it will include bovine blood and blood products in the materials banned from use in animal feed.	This action was never published as a rule in the Federal Register.
July 14, 2004	FDA posts interim final rule banning use of any SRMs in cosmetics or dietary supplements.	These materials were already banned from the human food supply.
July 9, 2004	FDA releases recommendation that all specified risk materials be banned from all animal feed and that dedicated lines and equipment be used in rendering to process any SRMs.	This recommendation has passed the public comment stage and can be made into a rule very quickly, should FDA think it is necessary.
September 30, 2004	FDA releases Level 1 guidance to industry that no material from BSE-positive cattle be used in any animal feed	

Note: This timeline summarizes information from Fox and Peterson and Franco. The authors recommend both of the sources for a non-technical presentation of the chronology of BSE and related policies in the United States (Franco) and abroad (Fox and Peterson). Some information was also taken from www.BSEinfo.org.

Appendix 2

Beef and By-product Categories.
Meat of bovine animals, boneless, except processed, fresh or chilled
Meat of bovine animals, boneless, except processed, frozen
Meat of bovine animals, cuts with bone in, except processed, frozen
Beef tripe, frozen
Other edible offal of bovine animals, frozen
Meat of bovine animals, fresh or chilled, boneless, processed
Tongues of bovine animals, edible, frozen
Meat or meat offal of bovine animals, NESOI , prepared or preserved
Livers of bovine animals, edible, frozen
Meat of bovine animals, cuts with bone in, except processed, fresh or chilled
Bovine semen
Meat of bovine animals, frozen, boneless, processed
Bovine animals, live, NESOI
Meat of bovine animals, frozen, other cuts with bone in, processed
Guts, bladders and stomachs of animals; beef intestine frozen
Lips of bovine animals, frozen
Bovine animals, live, purebred breeding, dairy, female
Offal of bovine animals, edible, fresh or chilled
Meat of bovine animals, fresh or chilled, other cuts with bone in, processed
Hearts of bovine animals, frozen
Meat of bovine animals, salted, in brine, dried or smoked
Carcasses and half-carcasses of bovine animals, NESOI, fresh or chilled
Carcasses and half-carcasses of bovine animals, NESOI, frozen
Dairy cattle embryos
Bovine animals, live, purebred breeding, dairy, male
Bovine animals, live, purebred breeding, except dairy, female
Bovine animals, live, purebred breeding, except dairy, male
Carcasses and half-carcasses of veal, fresh or chilled
Kidneys of bovine animals, frozen
Cattle embryos, except dairy cattle
Carcasses and half-carcasses of veal, frozen
Sweetbreads of bovine animals, frozen
Brains of bovine animals, frozen

Appendix 3

Beef Offal Categories.
Beef tripe, frozen
Other edible offal of bovine animals, frozen
Tongues of bovine animals, edible, frozen
Meat or meat offal of bovine animals, NESOI, prepared or preserved
Livers of bovine animals, edible, frozen
Guts, bladders and stomachs of animals; beef intestine frozen
Lips of bovine animals, frozen
Offal of bovine animals, edible, fresh or chilled
Hearts of bovine animals, frozen
Kidneys of bovine animals, frozen
Sweetbreads of bovine animals, frozen
Brains of bovine animals, frozen

Appendix 4

Methodology for Estimating 2004 BSE-Related Trade Loss.

Assume that the U.S. beef demand curve is linear. Thus, the 2004 U.S. Domestic Demand equation can be written as follows:

$$P = a \times Q + B \qquad (3.1)$$

where P is price, *a* is the slope, Q is quantity of beef, and *B* is the intercept. The domestic own price elasticity is defined as:

$$e = \frac{\partial Q}{\partial P} \times \frac{P_{2004}}{QD_{2004}} \qquad (3.2)$$

This implies:

$$\frac{\partial P}{\partial Q} = \frac{P_{2004}}{e \times QD_{2004}} \qquad (3.3)$$

Therefore, the slope of the demand equation can be expressed as a form of the own price elasticity as follows:

$$a = \frac{\partial P}{\partial Q} = \frac{P_{2004}}{e \times QD_{2004}} \qquad (3.4)$$

where *e* is the U.S. demand elasticity and QD_{2004} is the quantity of beef consumed in the United States in 2004. Assuming the demand curve's slope is unchanged, the new intercept can be calculated by solving the following equation:

$$P_{2004} = a \times QD_{2004} + B \qquad (3.5)$$

Replacing *a* with the expression above and solving for *B* gives:

$$B = P_{2004} \times \left(1 - \frac{1}{e}\right) \qquad (3.6)$$

Similarly, the 2003 international linear demand function for U.S. beef products can be written as:

$$P = \alpha \times q + \beta \qquad (3.7)$$

where

$$\alpha = \frac{P_{2003}}{r \times QE_{2003}}$$

$$\beta = P_{2003} \times \left(1 - \frac{1}{r}\right)$$

and *r* is the rest of the world demand elasticity and QE_{2003} is the quantity of beef exported from the United States during 2003.

The U.S. excess beef supply curve in the United States can be computed as the difference between quantity supplied and quantity demanded based on price faced by consumers.

We have the following demand equation for the U.S. consumer: $P = a \times Q + B$. It can equivalently be rewritten as:

$$QD = \frac{P - B}{a}$$

where QD stands for the quantity demanded by U.S. consumer facing price P.

Quantity supplied by the United States to the rest of the world, designated QE, can be calculated by taking quantity supplied minus quantity demanded. Therefore we have:

$$QE = QS - QD \tag{3.8}$$

Replacing quantity demanded by the expression previously calculated yields:

$$QE = QS_{2004} - \frac{P - B}{a}$$

where QS_{2004} is the quantity supplied in 2004. (3.9)

This equation is the excess supply equation representing the quantity the United States would be willing to export at a world price P.

In the absence of the BSE induced trade disruption, we assume that the international beef demand curve would have been unchanged from 2003. This means the price that would have been faced by the United States (PT_{2004}) can be calculated by solving for P in the following system of equations:

$$\begin{cases} PT_{2004} = \alpha \times Qe + \beta \\ Qe = QS_{2004} - \dfrac{P - B}{a} \end{cases} \tag{3.10}$$

Solving the system leads to the following expression for PT_{2004}:

$$PT_{2004} = P = \left[\alpha \times (QS_{2004} + \frac{B}{a} + \beta \right] \frac{a}{a + \alpha} \tag{3.11}$$

Given this estimate for PT_{2004}, we can express the loss to the U.S. beef industry (graphically depicted by the shaded rectangle in Figure 3.7) to be:

$$(PT_{2004} - P_{2004})\, QS_{2004} \tag{3.12}$$

Abbreviations

AMR	Advanced Meat Recovery
AMS	Agricultural Marketing Service
ANPR	Advance Notice of Proposed Rule Making
APHIS	Animal and Plant Health Inspection Unit
BEV	Beef Export Verification
BSE	Bovine Spongiform Encephalopathy
CJD	Creutzfeld-Jacob Disease
vCJD	Variant Creutzfeld-Jacob Disease
DRG	Dorsal Root Ganglia
FAS	Foreign Agricultural Service
FDA	Food and Drug Administration
FSIS	Food Safety Inspection System
HACCP	Hazard Analysis of Critical Control Points
IHC	Immunohistochemistry
IRT	International Review Team
LMIC	Livestock Marketing Information Center
MBM	Meat and Bone Meal
MS	Mechanically Separated
NAFTA	North American Free Trade Agreement
NESOI	Non-Elsewhere Specified or Included
OTM	Over 30 Months of Age
PBM	Porcine Blood Meal
RBM	Ruminant Blood Meal
SOP	Standard Operating Procedure
SRM	Specified Risk Material
SSOP	Sanitation Standard Operating Procedures
TSE	Transmissible Spongiform Encephalopathy
USDA	United States Department of Agriculture
UTM	Under 30 Months of Age

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